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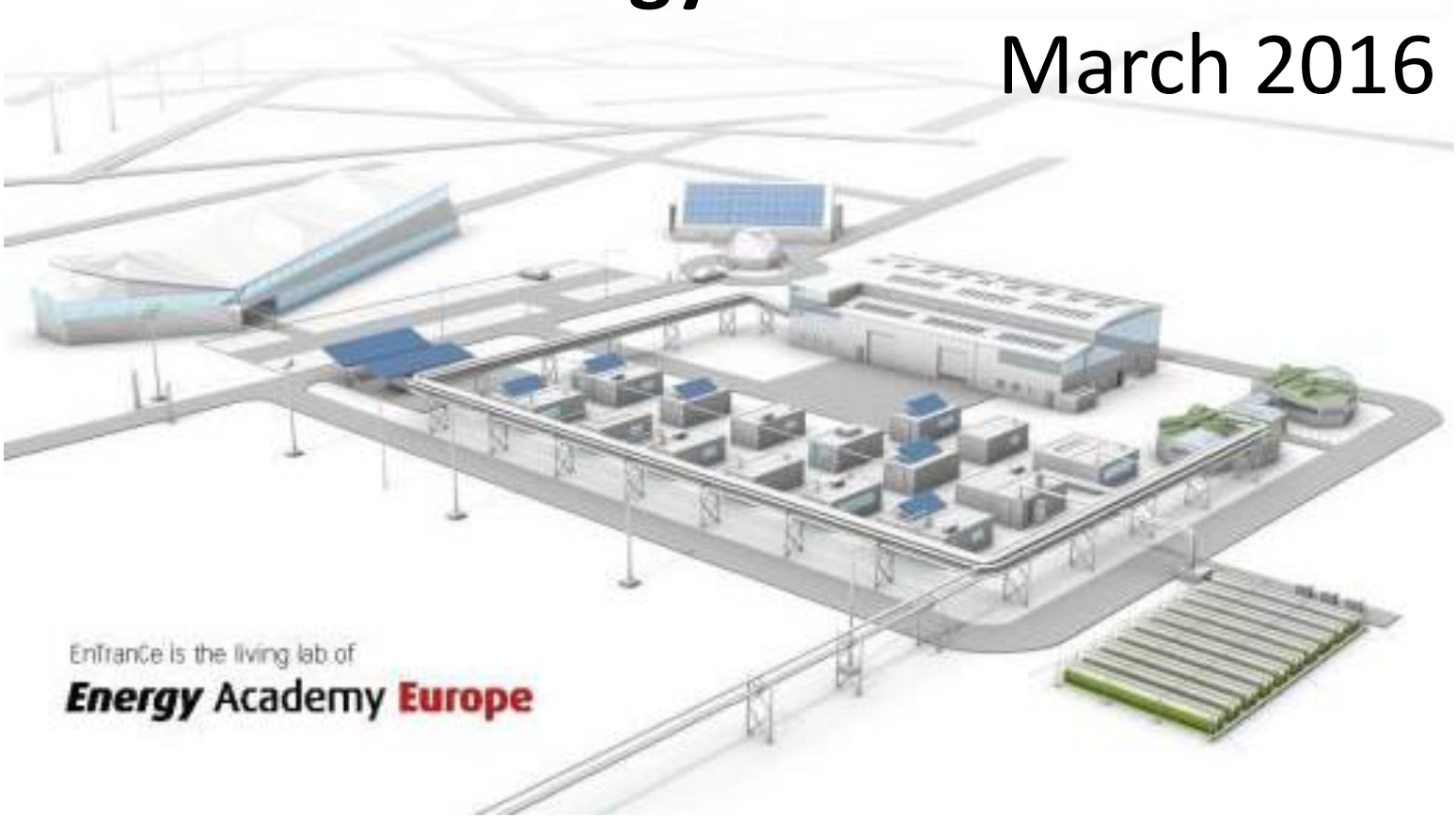
Renewable Energy in The Netherlands
March 2016



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This analyses contains information of various sources and own analyses, including various estimates.

Readers are encouraged to add, to improve the quality of the information provided.

The Entrance database on Renewable Energy is regularly improved by the creation of more sophisticated (sub)models

Recent improvements

February: 2016 New graphs are added, representing the four main sectors that need energy: low temperature heating, high temperature industry, transportation and power

March 2016: the models for renewable energy from wood stoves, fireplaces and heat pumps for heating of buildings have been improved. Data from previous months and years have been corrected. Using these models

March 2016: the individual contributions per month of various sources of renewable energy are presented.

March 2016

In a Nutshell

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- The percentage renewable power was 10.7%, down from 11.5% last year.
- Renewable power varied between 5% (on March 7th) and 27% on March 28th)
- The fraction renewable energy was 5.0%, down from 5.3% last year
- Electricity production by wind was 8% lower y-o-y and reached 0.6 TWh.
- Electricity production by solar-PV was 30% higher y-o-y and reached 0.1 TWh
- Average utilization of wind capacity was 24% and of solar-PV, it was 8%
- Coal-fired power decreased by 7% and gas-fired power decreased by 4% y-o-y
- CO2 emissions were stable at 16.1 Mton up from 16.0 Mton last year

Content

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- March 2016 data
- Monthly profiles
- Monthly data
- Hourly data
- Miscellaneous

SELECTED ENERGY DATA FROM MARCH 2016

Renewable Energy

March 2016

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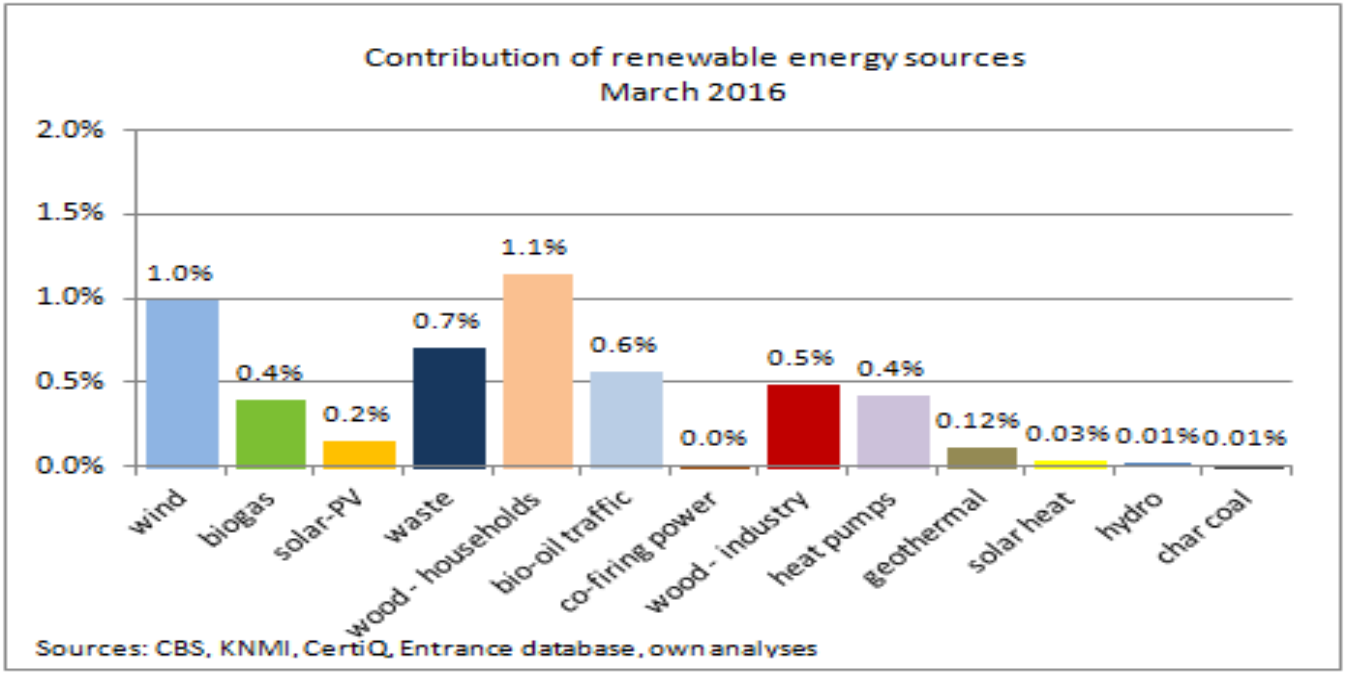

Renewable Energy is produced in various forms. The most important contributor is biomass. In March 2016, according to the official rules, 5.0% of all energy was renewable energy.

Final Energy Demand

March 2016

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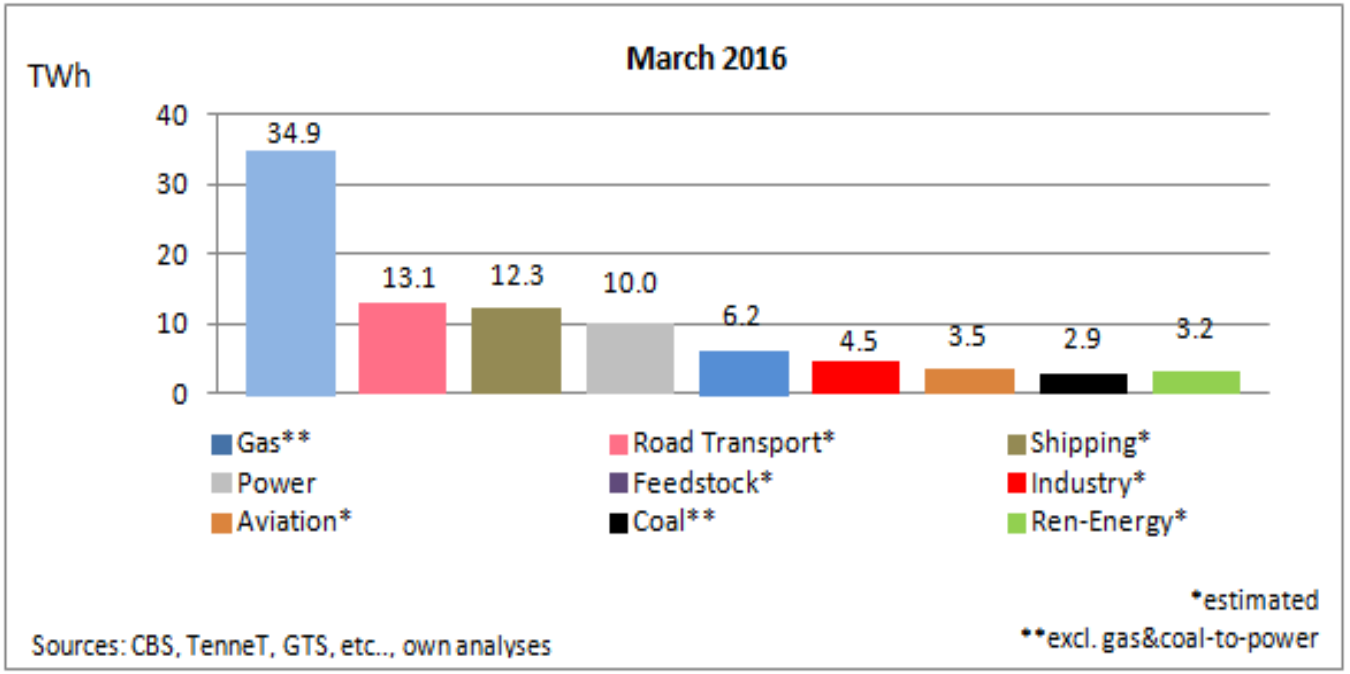

Energy is used for many different purposes. In March 2016, the most important energy applications were gas and various forms of transport.

Final Energy Demand March 2016 (vs 2015)

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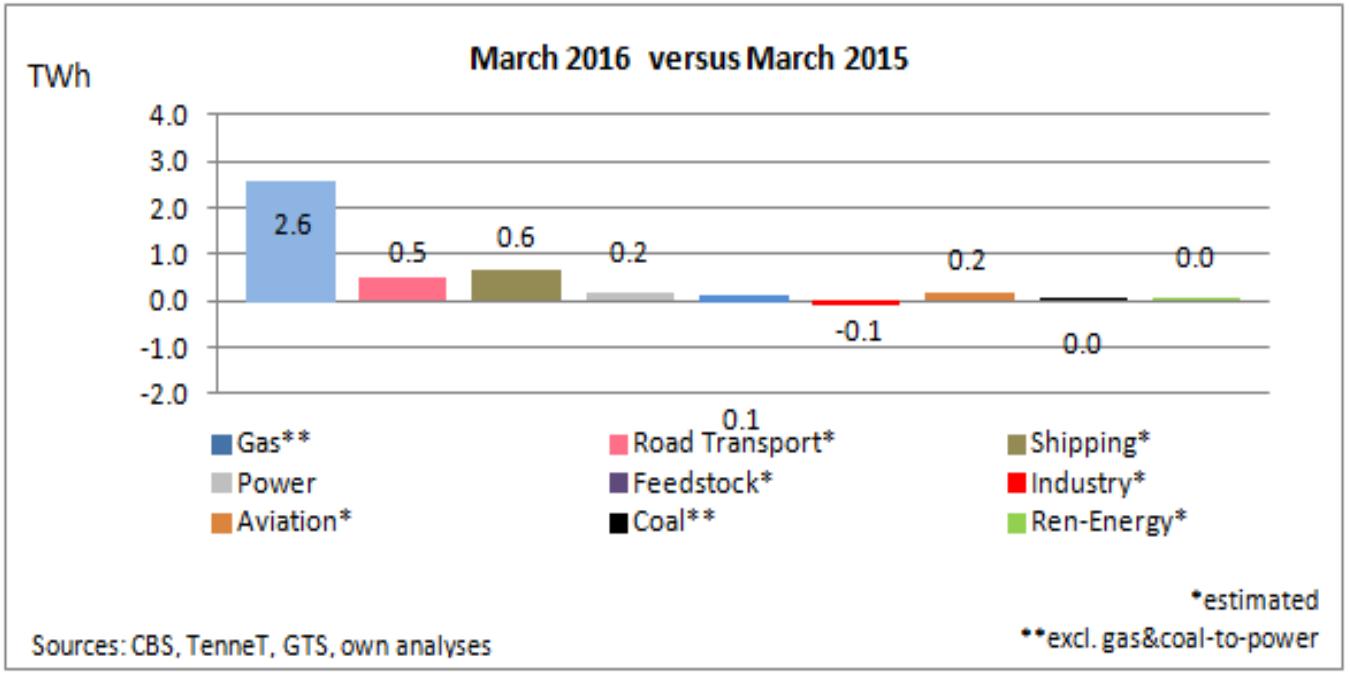

In March 2016, gas demand has been lower than last year.

CO2 Emissions
March 2016

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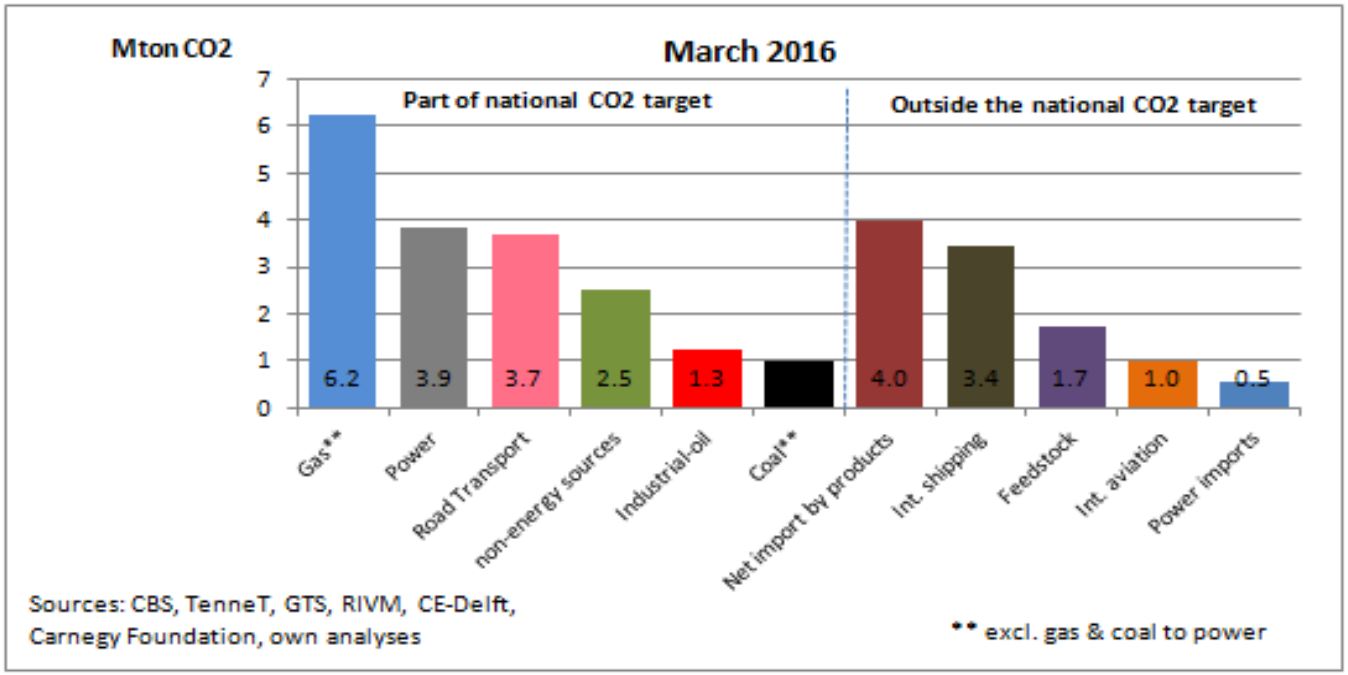

In March, the national energy-related CO2 emissions, calculated using the official formula, are estimated at 16.1 Mton, up from 16.0 Mton in March 2015.

Power Generation Capacity March 2016

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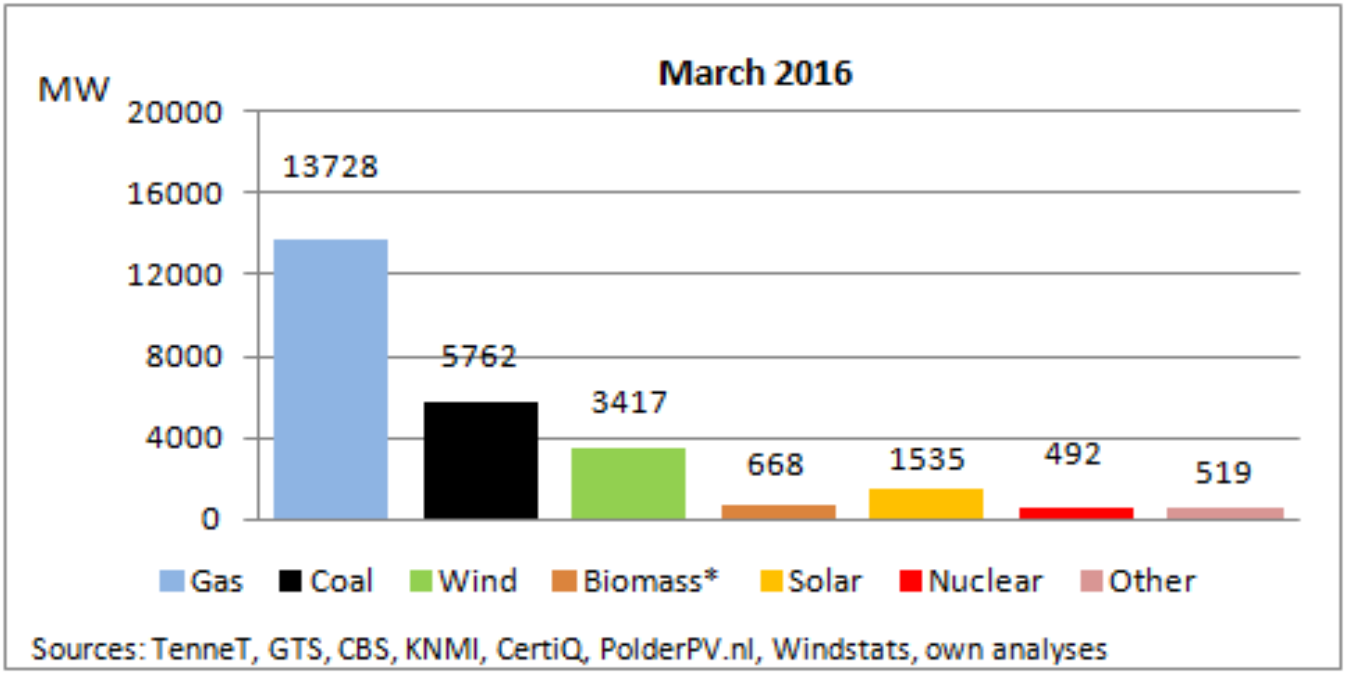

The capacity (beginning of March) is the so-called name-plate capacity. In practice, not all capacity is available for the market due to planned and unplanned maintenance.

Power Supplies

March 2016

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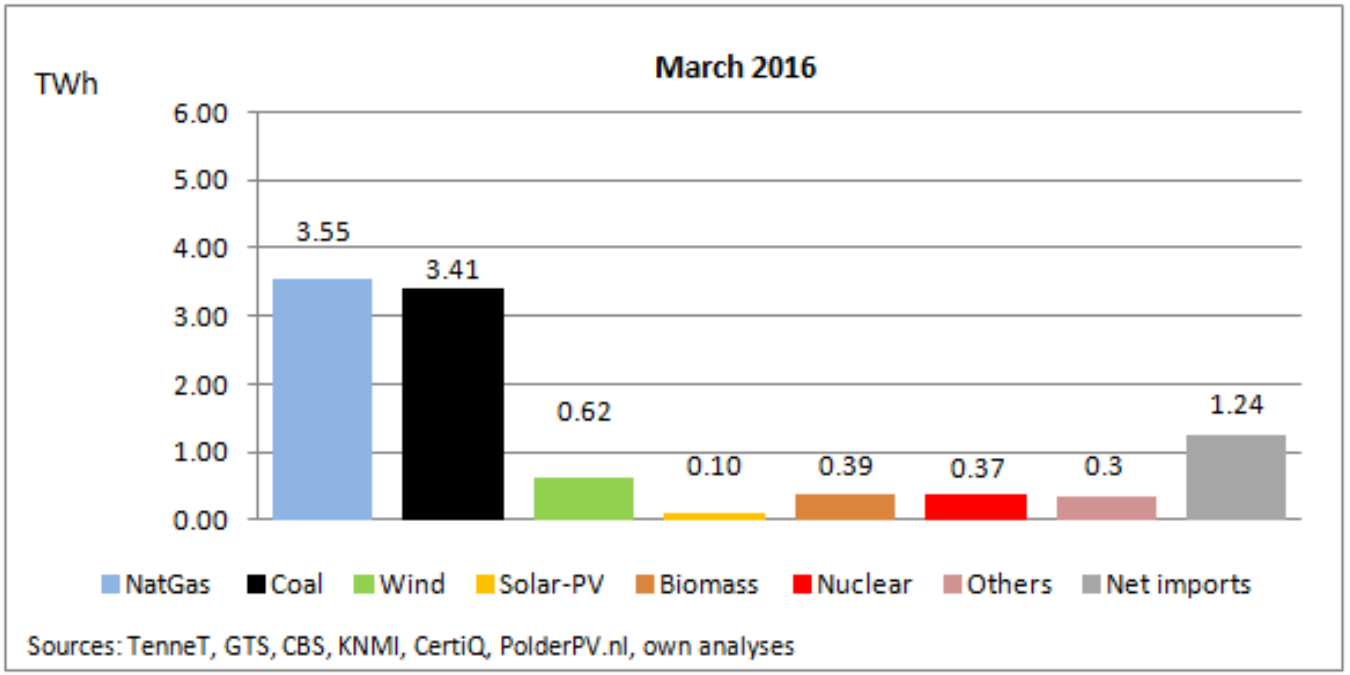

In March 2016, power consumption was 10 TWh, 2% higher than last year. For the third consecutive month, gas-fired power was larger than coal-fired power.

CO2 from Power Generation

March 2016

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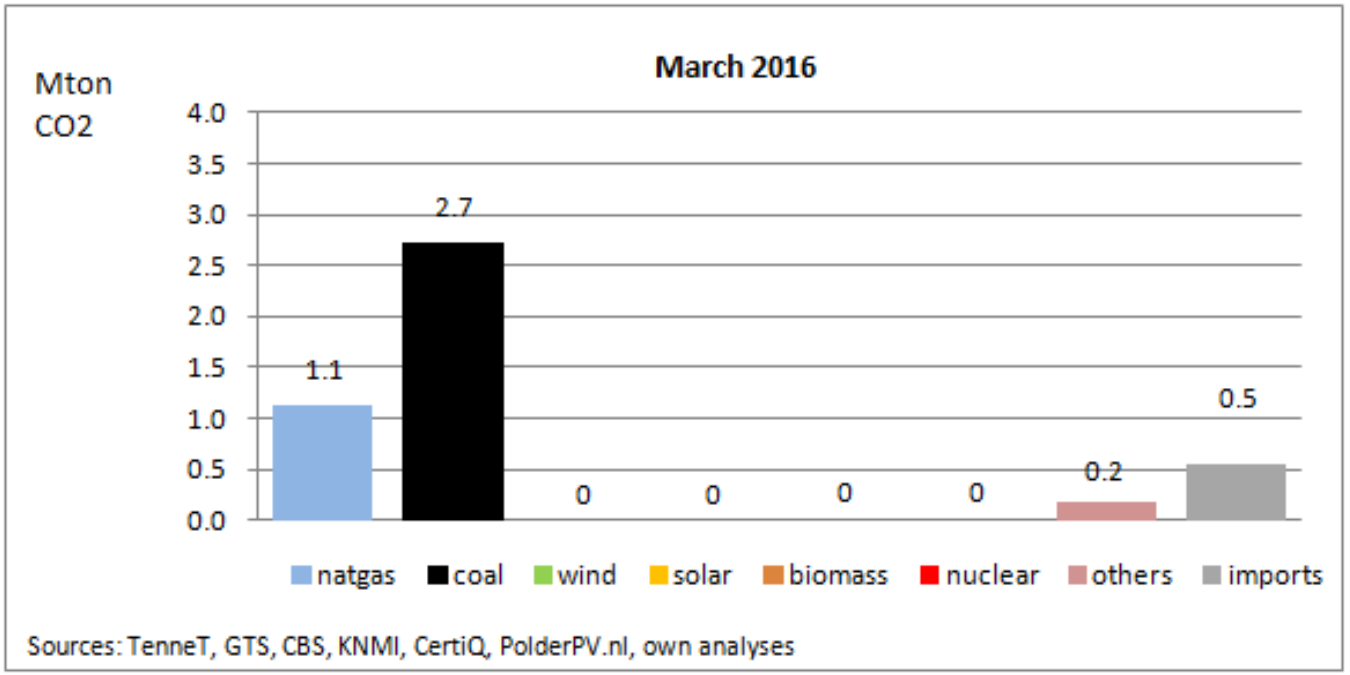

In March 2016, 70% of the CO2 emissions from the power sector came from the coal-fired power stations. The CO2 emissions from imports are given for comparison, since these do not contribute to the National CO2 emissions.

SELECTED MONTHLY PROFILES

(using daily data)

Daily Renewable Energy March 2016

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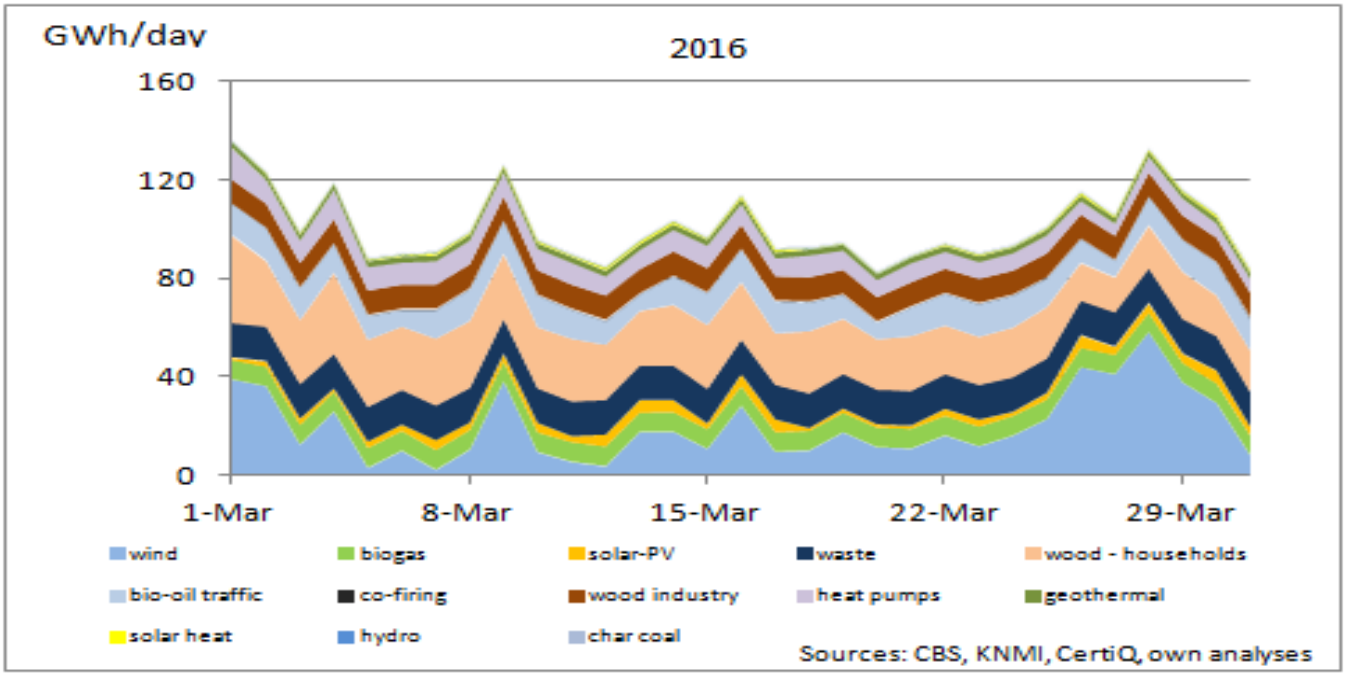

Various contributions of renewable energy per day, classification according to CBS. In March, the average Dutch final energy consumption was about 2000 GWh per day.

One GWh is one million kWh or about 100.000 m3 of natural gas.

Final Energy Demand March 2016

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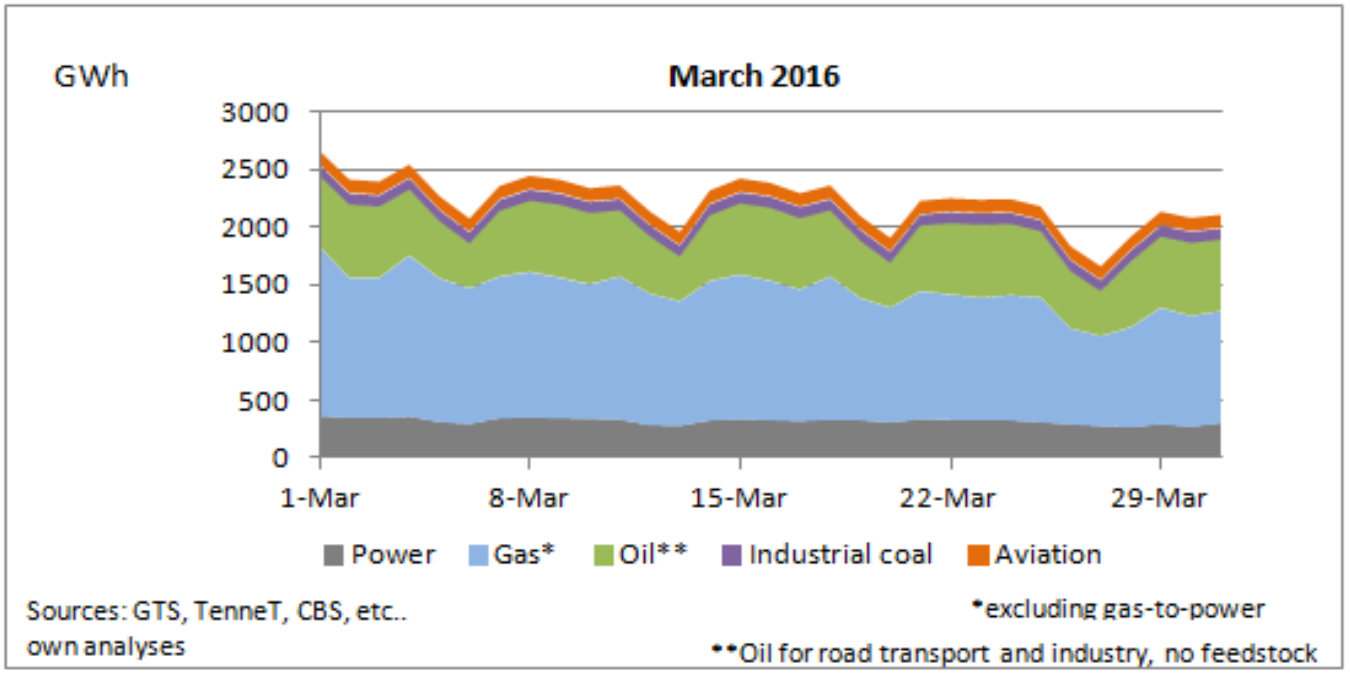

Energy demand shows a typical weekday-weekend pattern. Gas demand is as well dependent on ambient temperature. During the month, ambient temperatures rose and thus, energy consumption decreased.

Conventional Power Production March 2016

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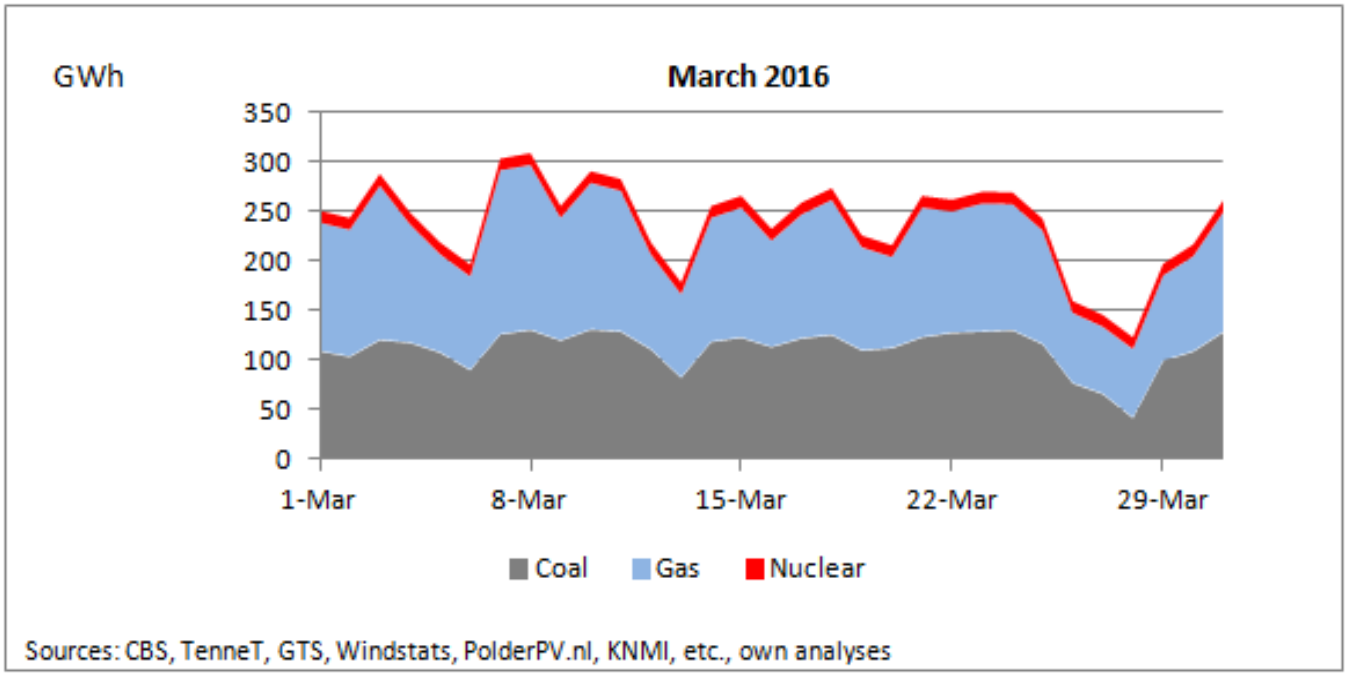

The week-weekend pattern of the coal-fired power stations is less pronounced then last year, due to the closure of some coal-fired capacity. Gas-fired generation is either must-run capacity or necessary to balance the system. From 27 to 29 March, fossil fuel generation was very low, because of low demand due to Eastern Holidays and a high availability of wind energy.

Wind and Solar Power Production March 2016

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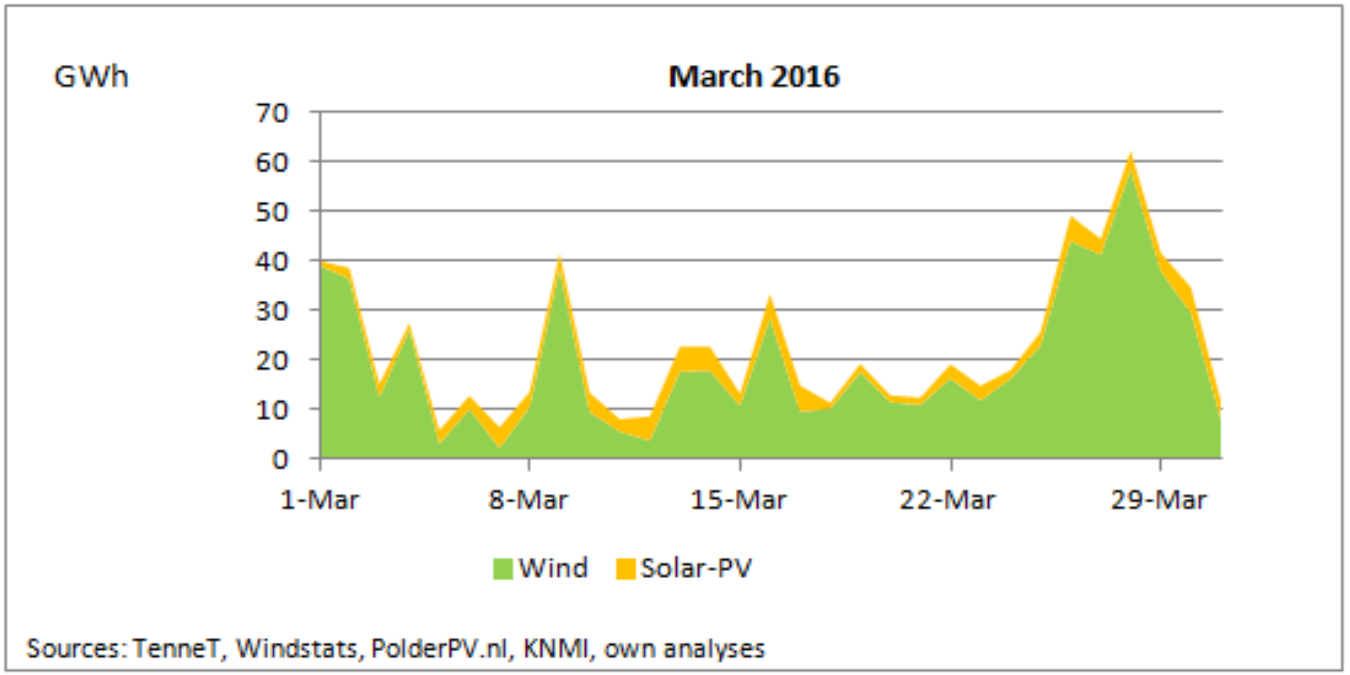

With the exception of the last week, March was not very windy and wind generation was 0.6 TWh, while the utilization rate of the wind turbines was only 24%. The utilization rate of solar-PV was 8%.

1 GWh is sufficient to provide power for a year to 300 households.

Contribution of Renewable Energy March 2016

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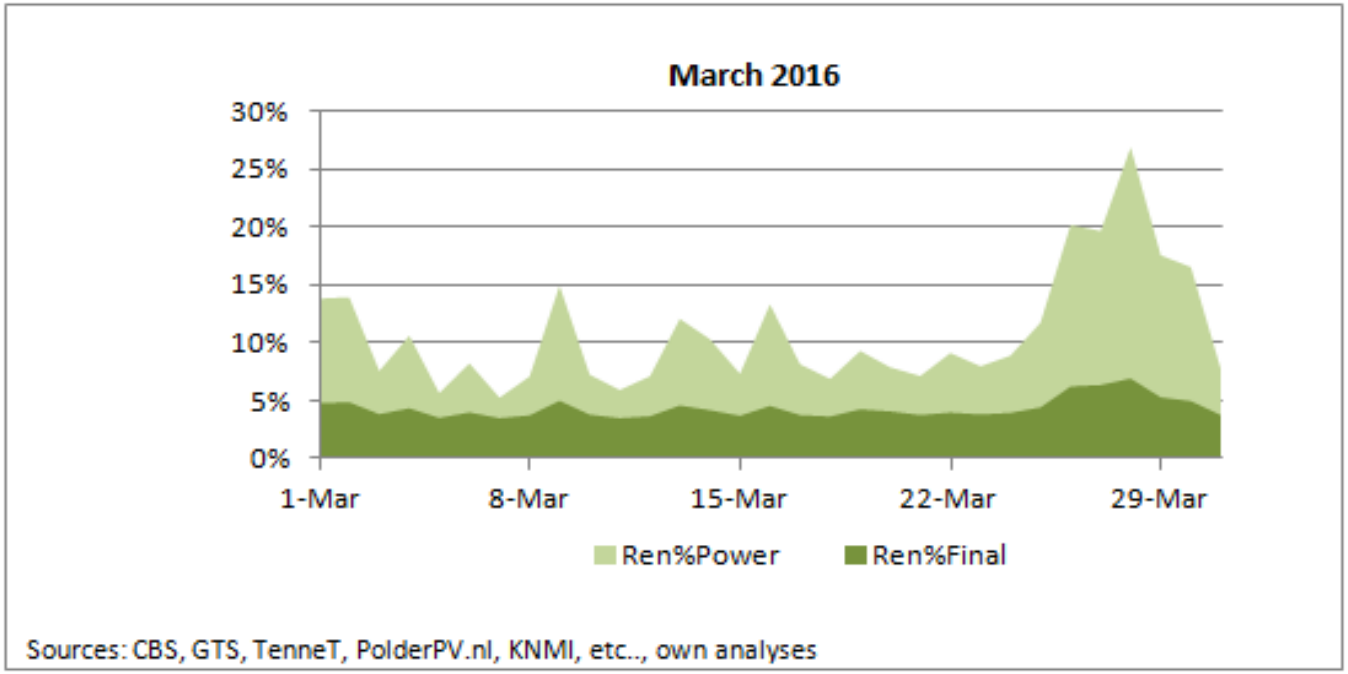

In March, the percentage of renewable power varied widely between 5% and 27%, with an average of 10.7%. The every percentage of renewable energy was 5.0%. These percentages renewable power and energy have been estimated using the formal EU/IPCC procedures.

SELECTED MONTHLY ENERGY DATA

Gross Final Energy Consumption 2016 (and 2015)

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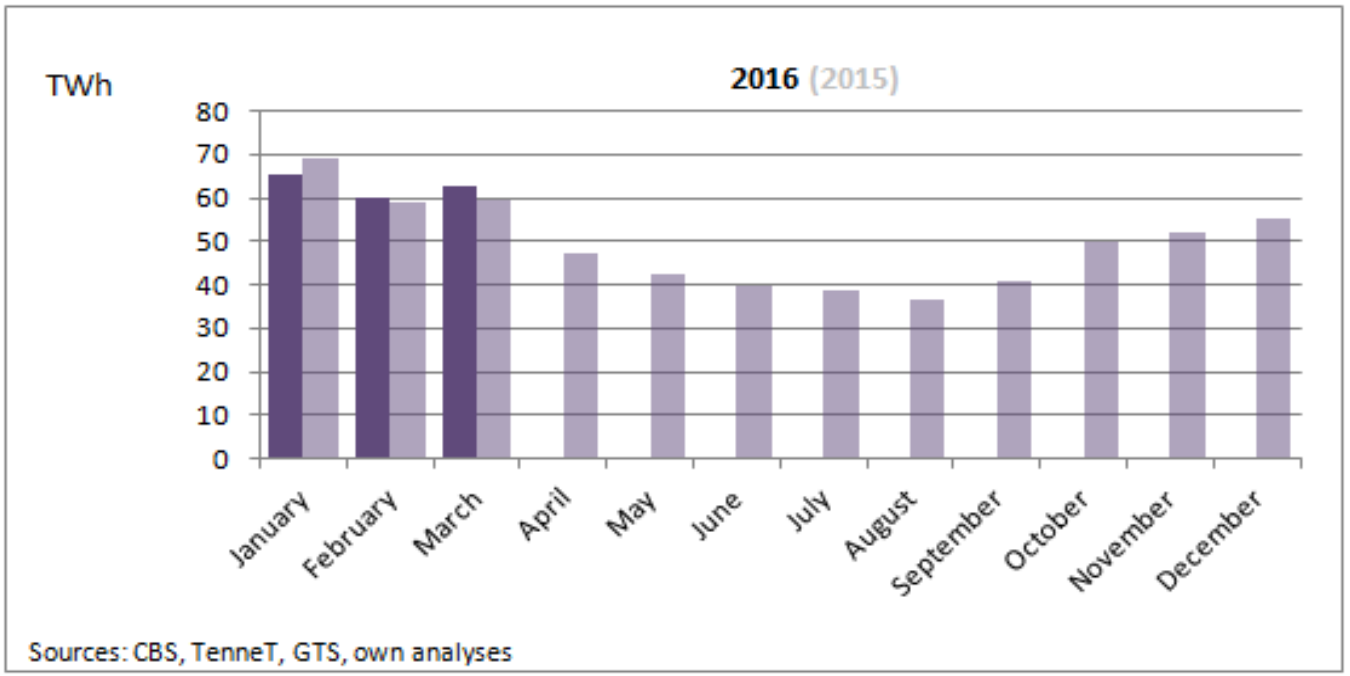

The gross final consumption of energy is a quantity used to calculate the percentage of renewable energy. This quantity excludes the energy used in the energy sector (mainly due to the production of electricity), for international shipping and for feedstock and the energy used for international aviation above 6.18% of the total

Gas Demand
(excluding gas-to-power)
2016 (and 2015)

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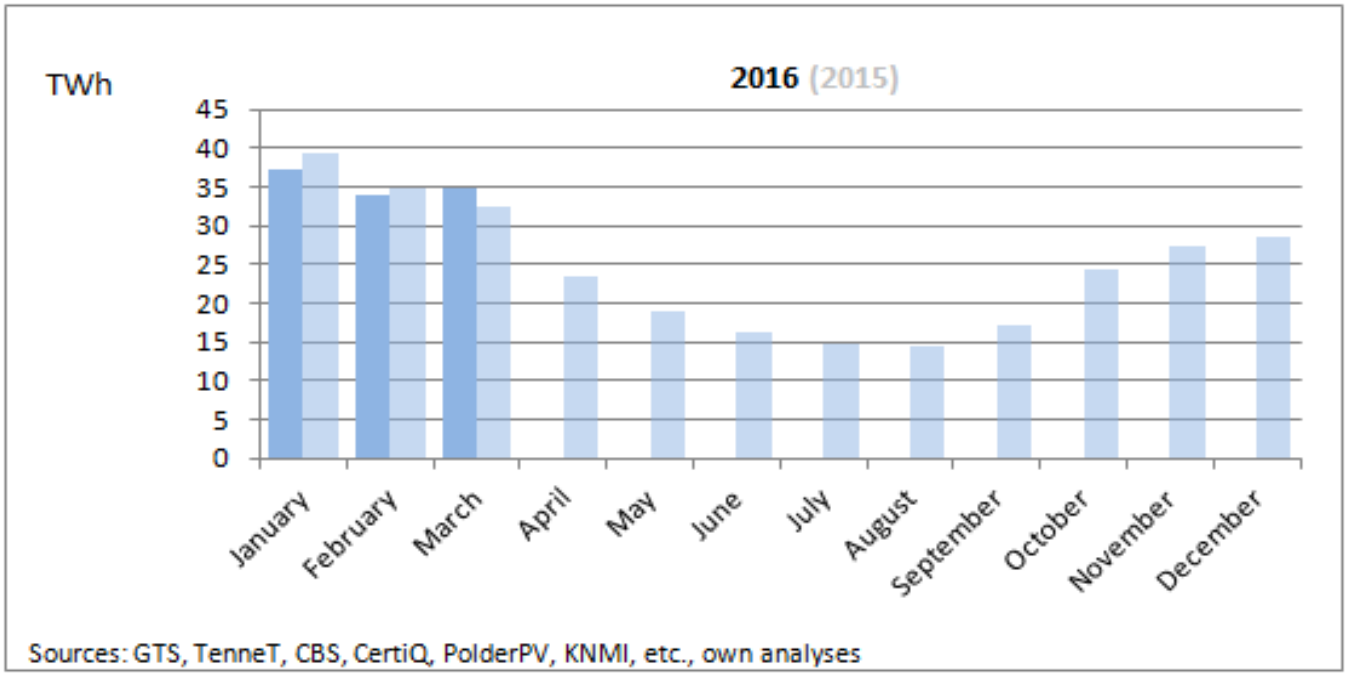
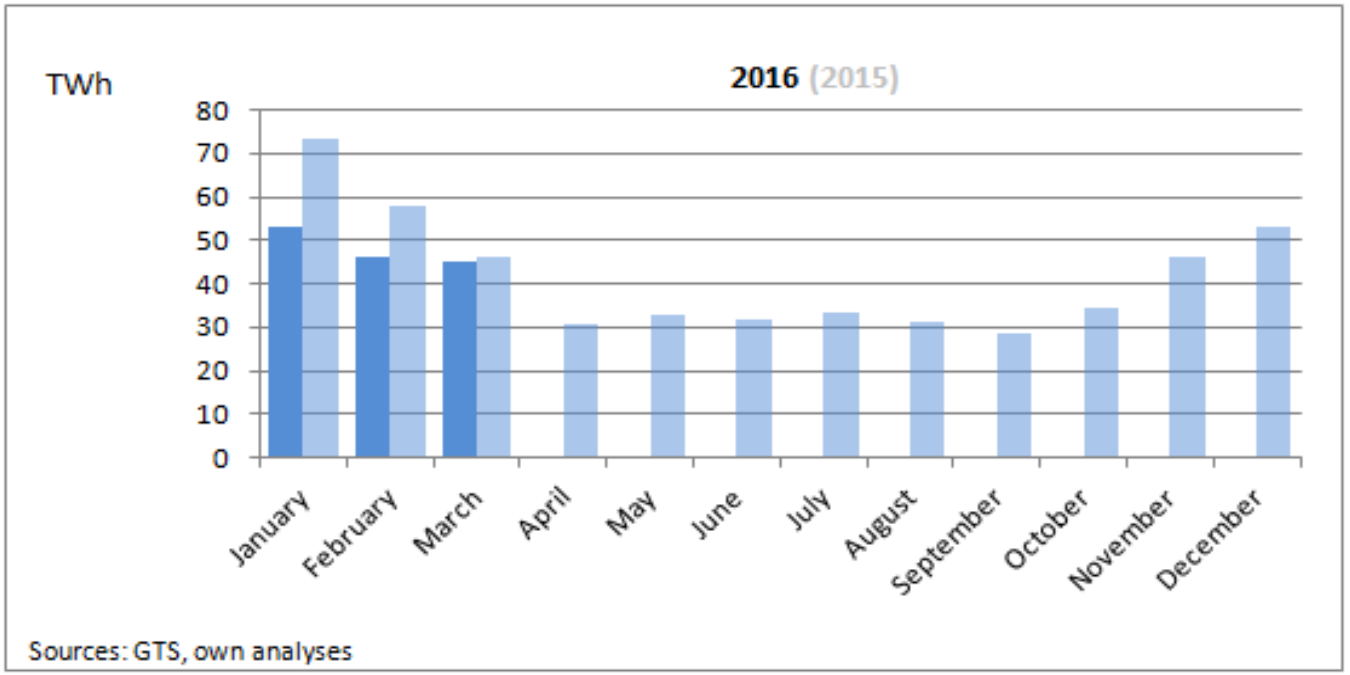


Gas consumption in March, excluding gas-to-power, was higher than last year, mainly due to higher gas demand in both distribution and industry.

Gas Production 2016 (and 2015)



The natural gas production in March was similar than last year.

Power Demand 2016 (and 2015)

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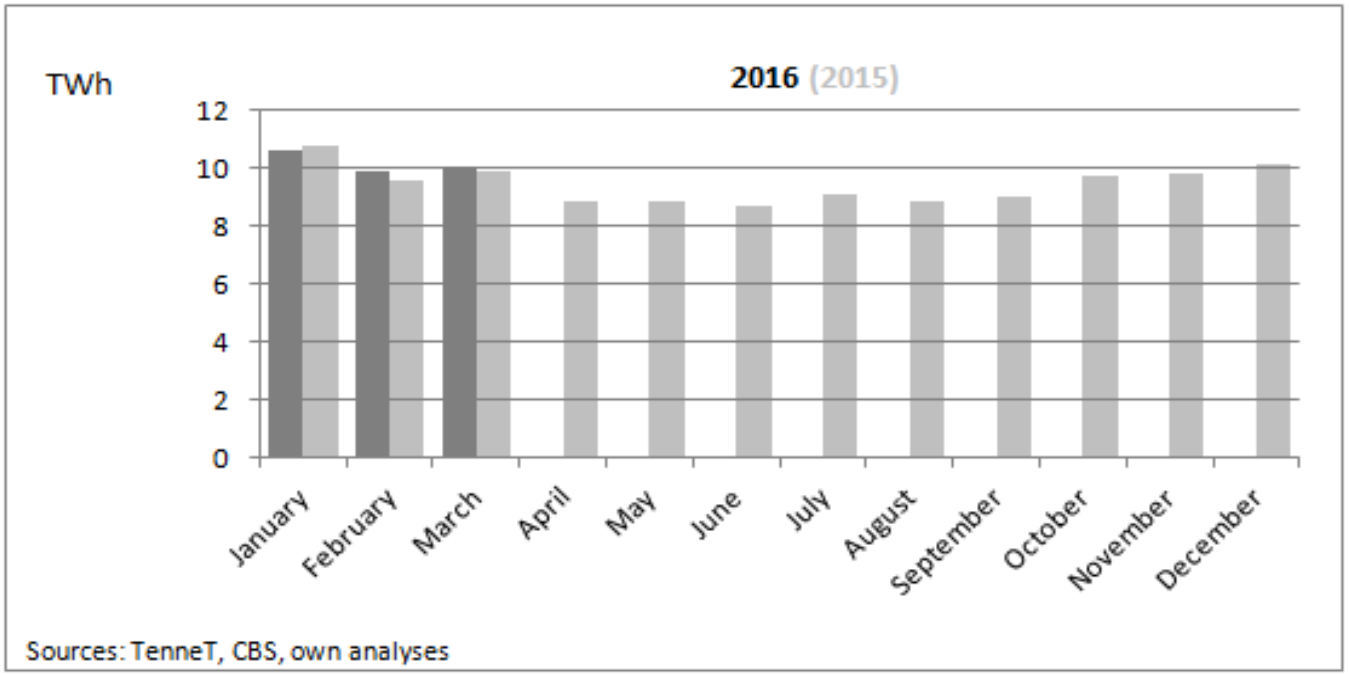

Power demand in March was 2% higher than last year.

Wind Production 2016 (and 2015)

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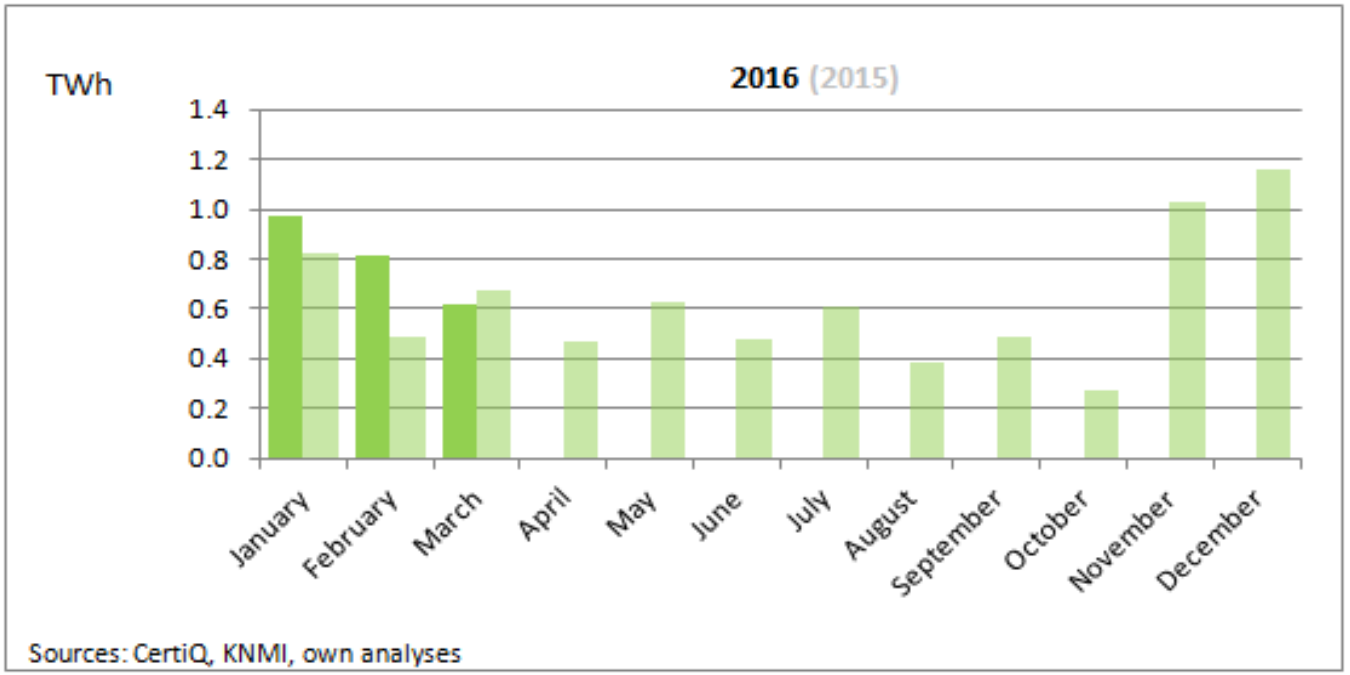

Wind production in March 2016 was almost 0.6 TWh, similar than last year. In March 2016, the average utilization of wind capacity was 24%.

Solar PV Production 2016 (and 2015)

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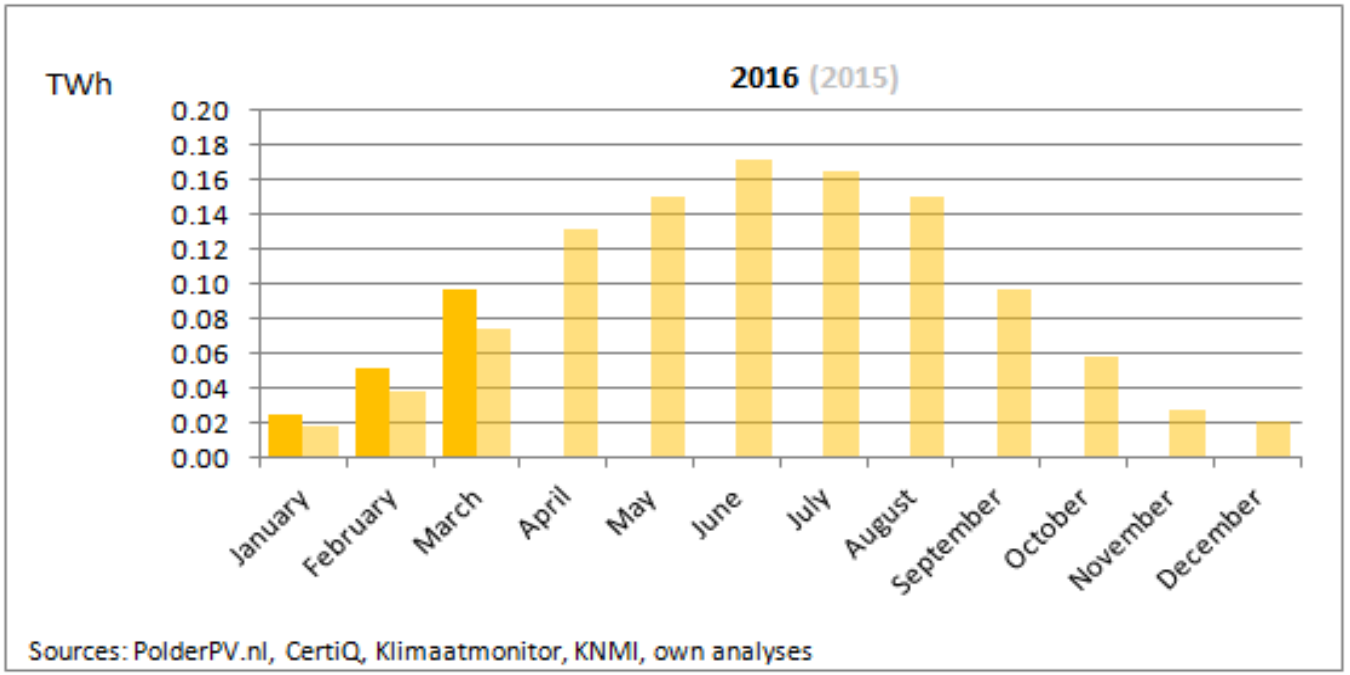

In March 2016, electricity generation by Solar PV in The Netherlands was much higher than last year, because of an increase in solar-PV capacity and more sunshine. In March, the average utilization rate of solar-PV capacity was 8%.

Coal-to-Power 2016 (and 2015)

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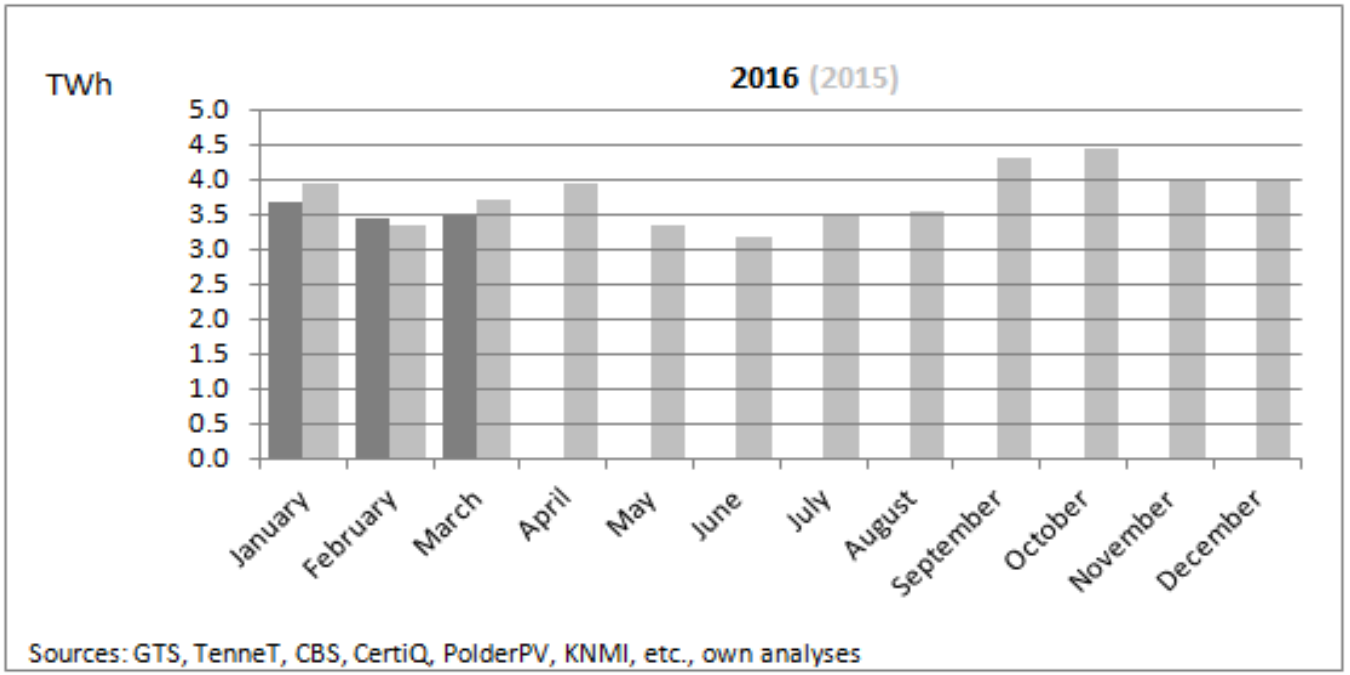

Coal-fired power generation n March has been estimated slightly lower than last year, due to the closure of a few old coal-fired power stations and because of the high availability of renewable power in the last week of March that caused coal-fired power to reduce output (see sheet 15).

Gas to Power
2016 (and 2015)

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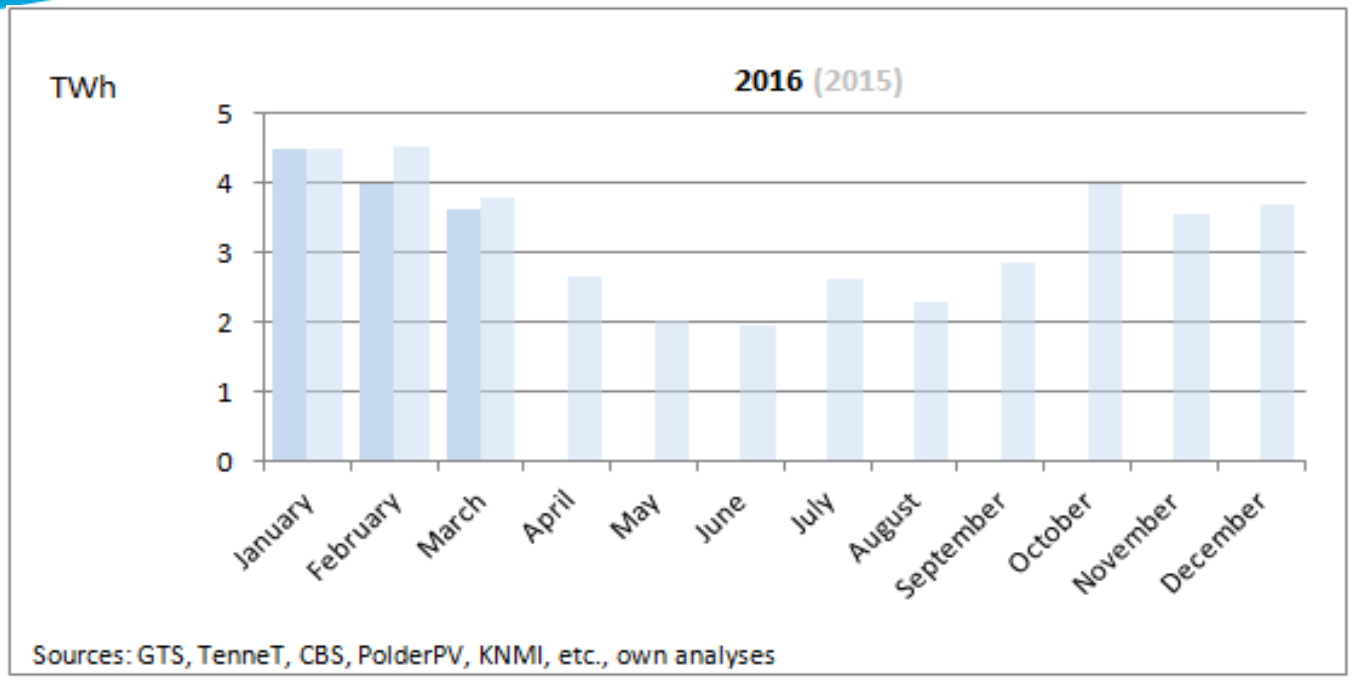
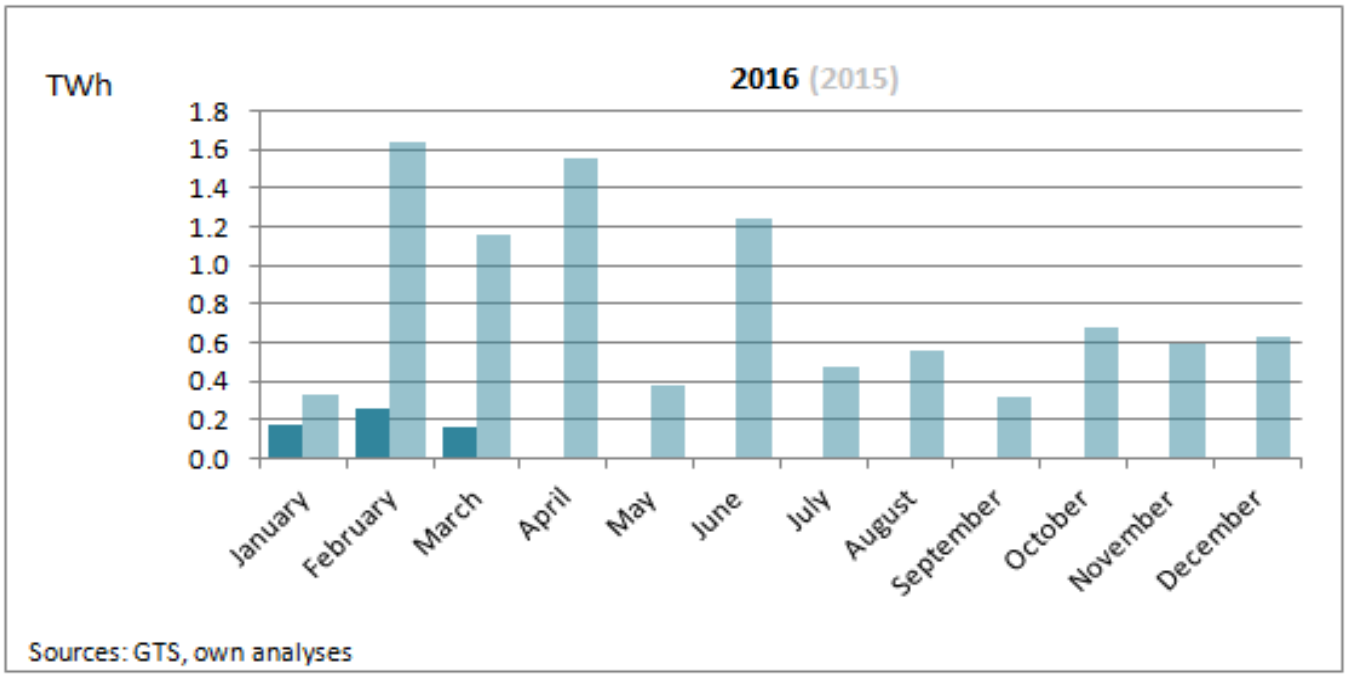


In March 2016, power production by gas-fired power stations and cogeneration was slightly lower than previous year.

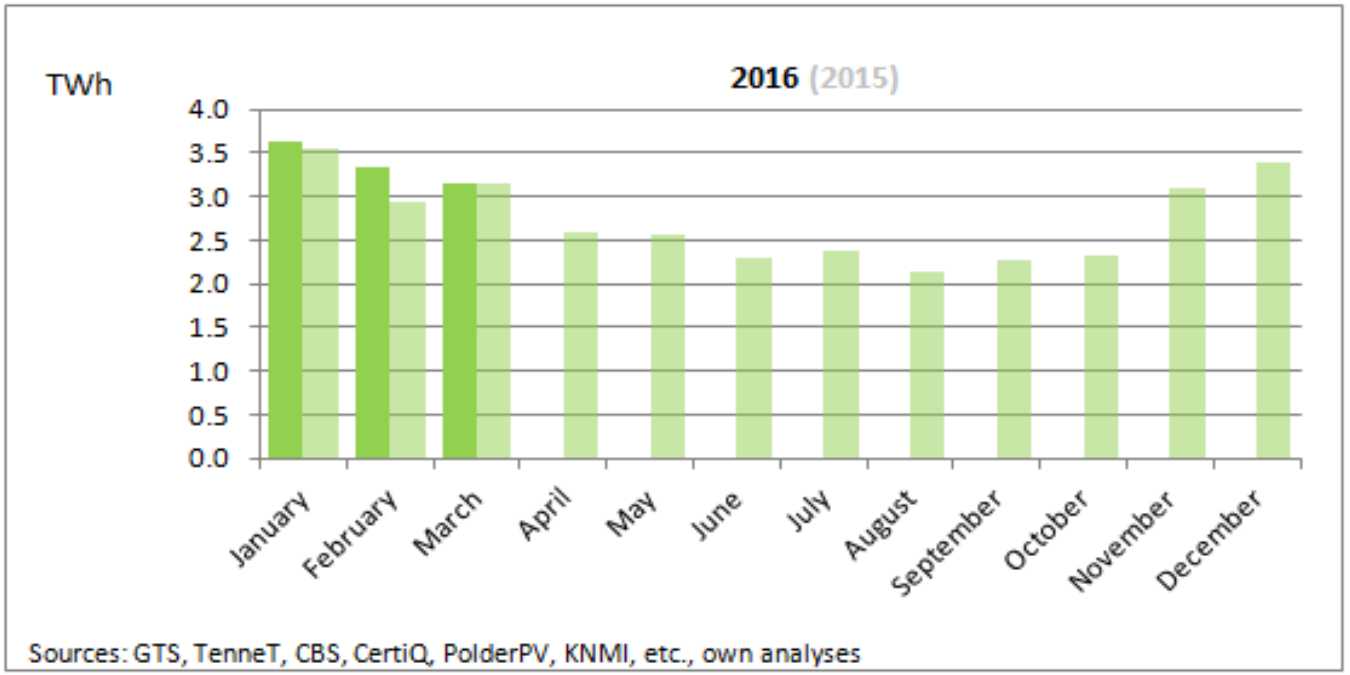
LNG imports 2016 (and 2015)



This figure depicts the amount of LNG injected into the gas grid, as presented by GTS. The figure excludes the usage of LNG as transport fuel. In March, LNG imports were substantially lower than a year ago.

Renewable Energy All Sources

2016 (and 2015)



More accurate models have been developed to estimate the daily renewable energy production by household wood stoves and fire places and heat pumps. Compared to the old approximation, renewable energy production increased in winter and decreased in summer. Over a year, there are no changes. The old data have been adjusted accordingly.

Renewable Energy Percentage 2016 (and 2015)

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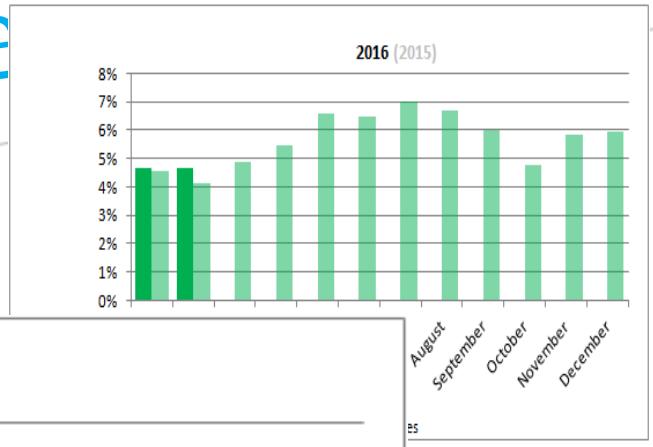
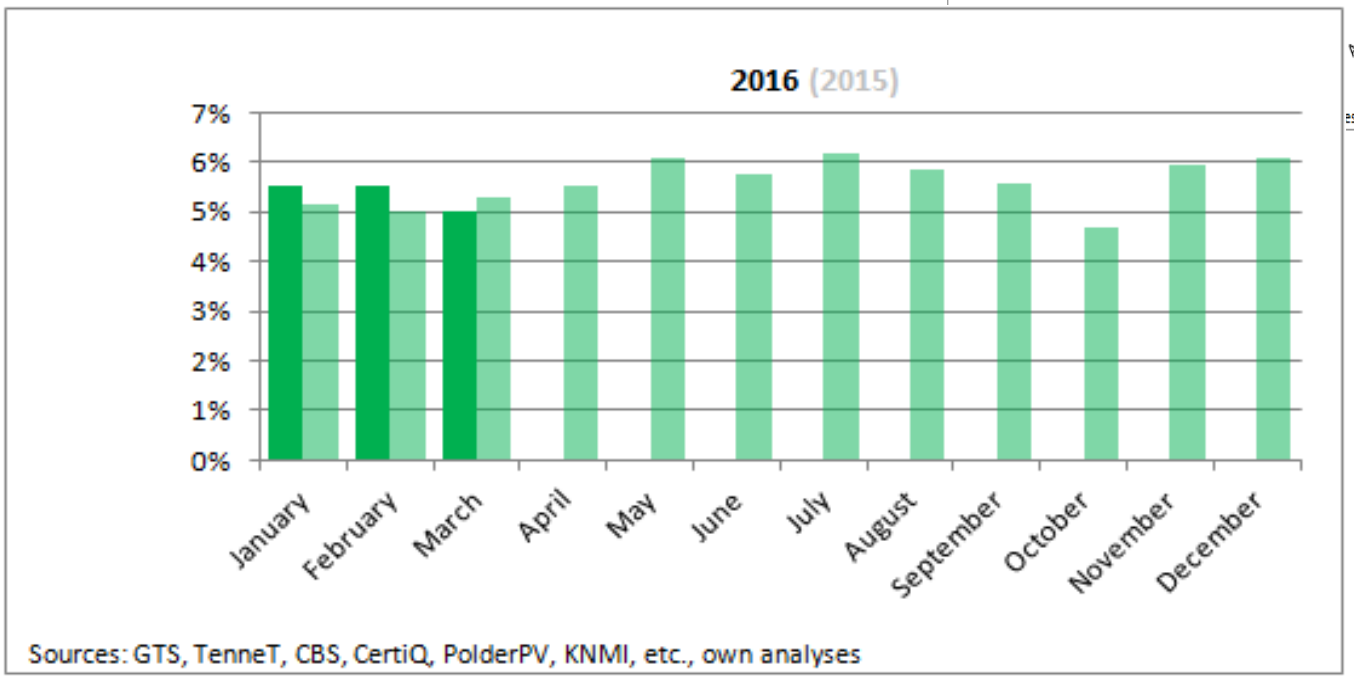
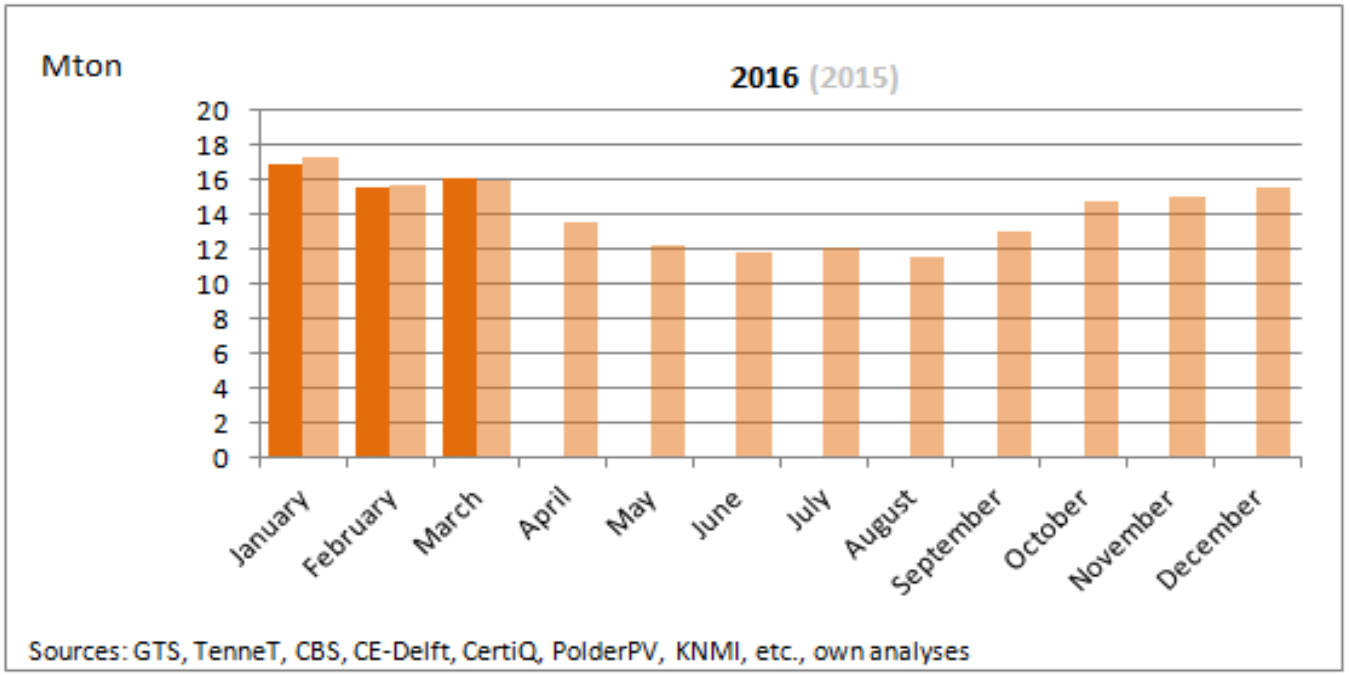




New models to estimate the renewable energy have been introduced and old data are adjusted, see previous slide. For comparison, the monthly data curve as calculated with the old models is shown in the upper corner. It may be observed that the new approximation results in a fairly constant percentage of renewable energy throughout the year

CO2 Emissions 2016 (and 2015)



After a significant rise of the CO2 emissions in 2015, compared to 2014, the CO2 emissions in the beginning of 2016 were a bit lower than last year.

ENERGY DEMAND IN A NUTSHELL

Energy Demand March 2016

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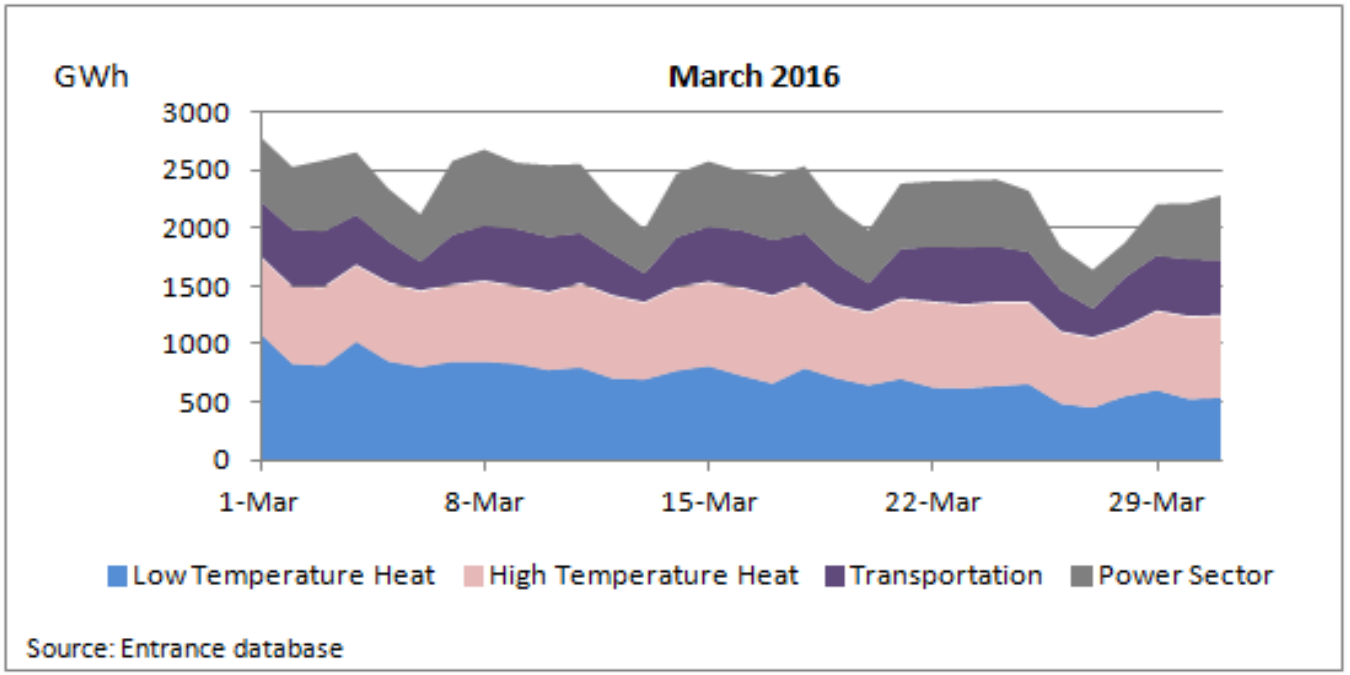
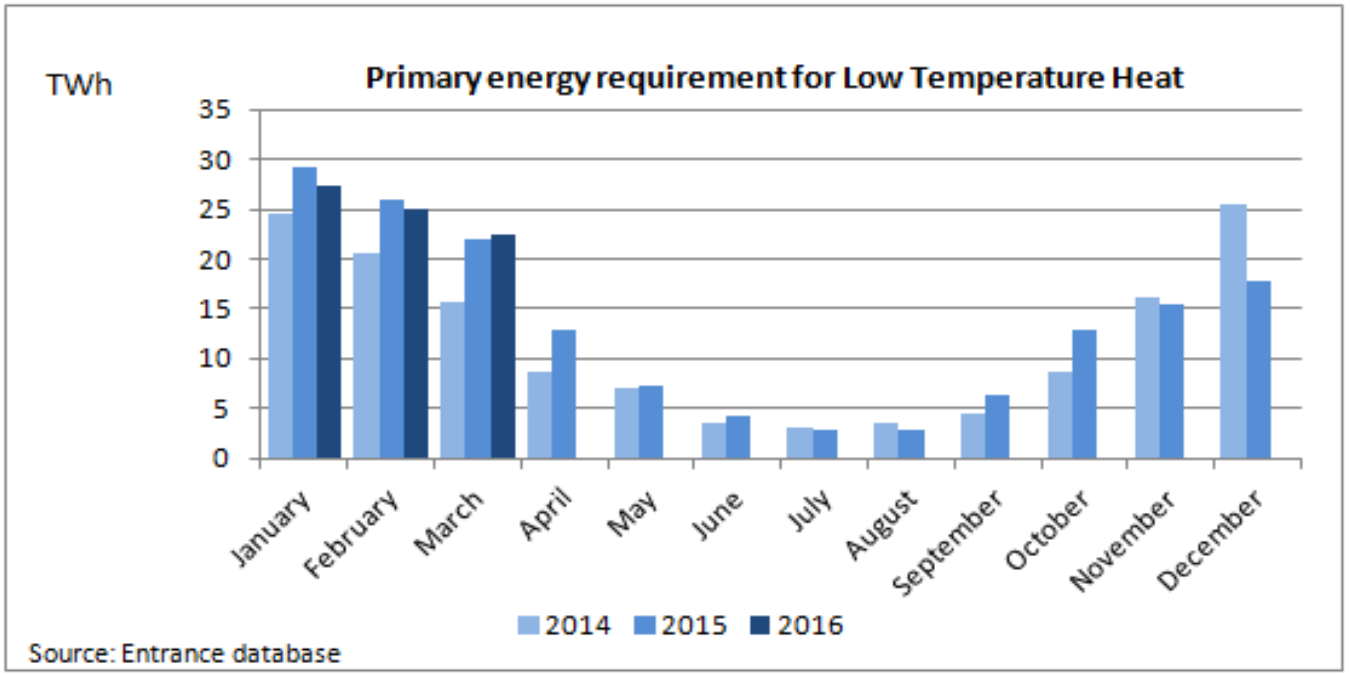


Dutch government has allocated Energy Demand in four categories. These categories (and this figure) do not take into account energy demand for international shipping, aviation and feedstock.

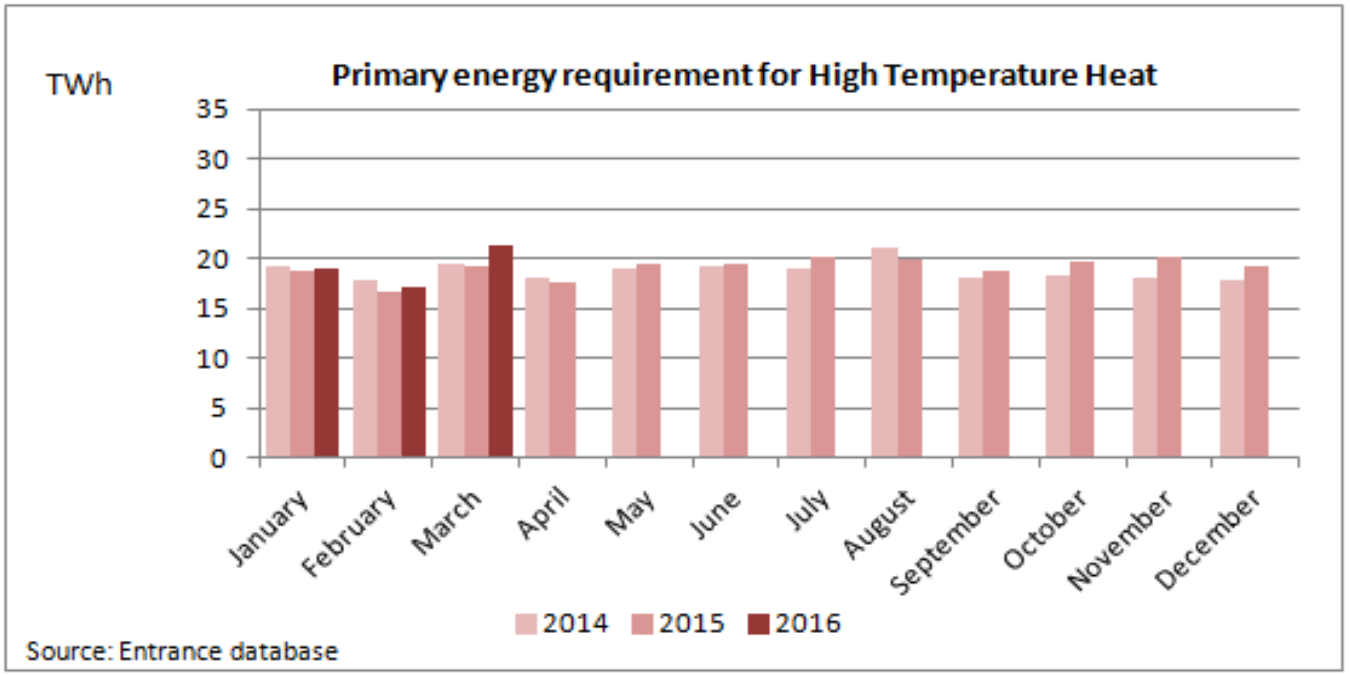
(1 GWh is about equal to the average daily energy production of 40 wind turbines of 3 MW each)

Energy Demand
Low Temperature Heat



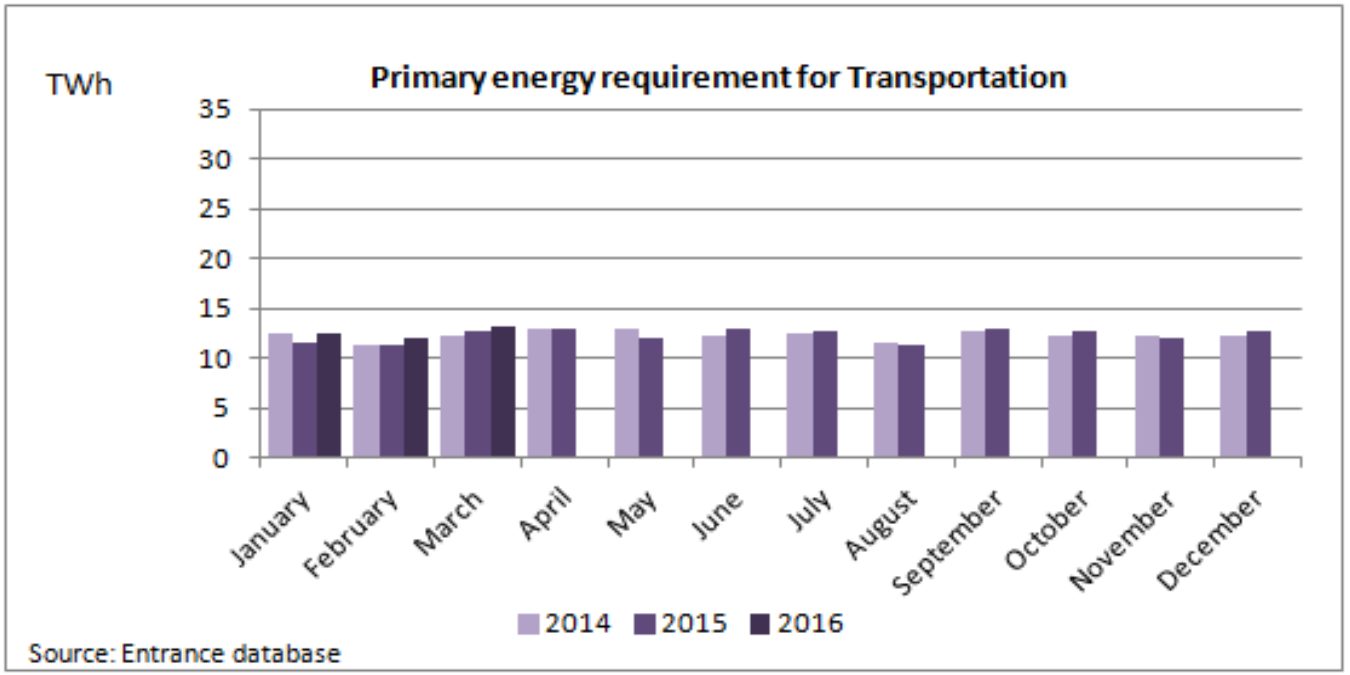
The primary energy requirement for Low Temperature heat, mainly buildings and green houses, varies with ambient temperature.

Energy Demand
High Temperature Heat



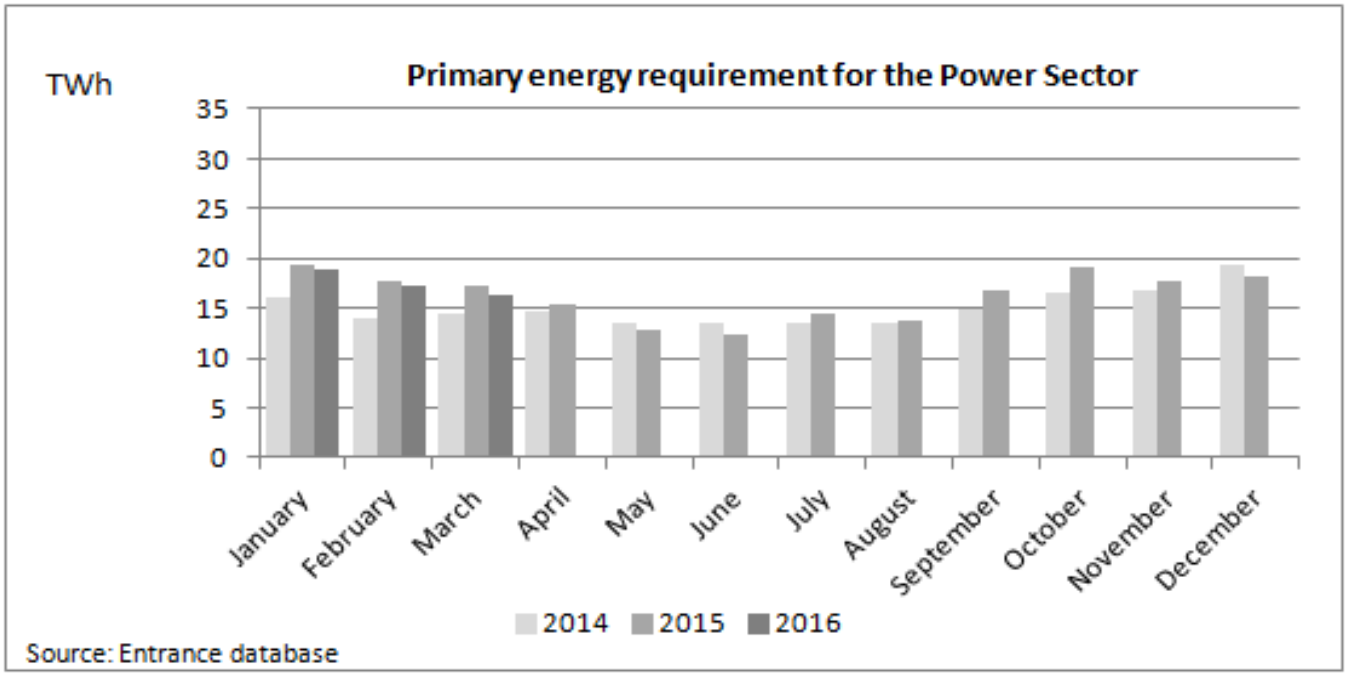
The primary energy requirement for High Temperature Heat (mainly industry) varies with the economic activity in the Netherlands.

Energy Demand Transportation



The primary energy requirement for Transportation (excluding international shipping and aviation) varies with the economic activity in the Netherlands. Fuels that are bought abroad, e.g. due to lower taxes, are not included in this figure.

Energy Demand Power Sector



The primary energy requirement for the power sector varies, with the import/export balance and with the production of renewable power. This figure excludes the primary energy demand caused by power imports.

CO2 Emissions March 2016

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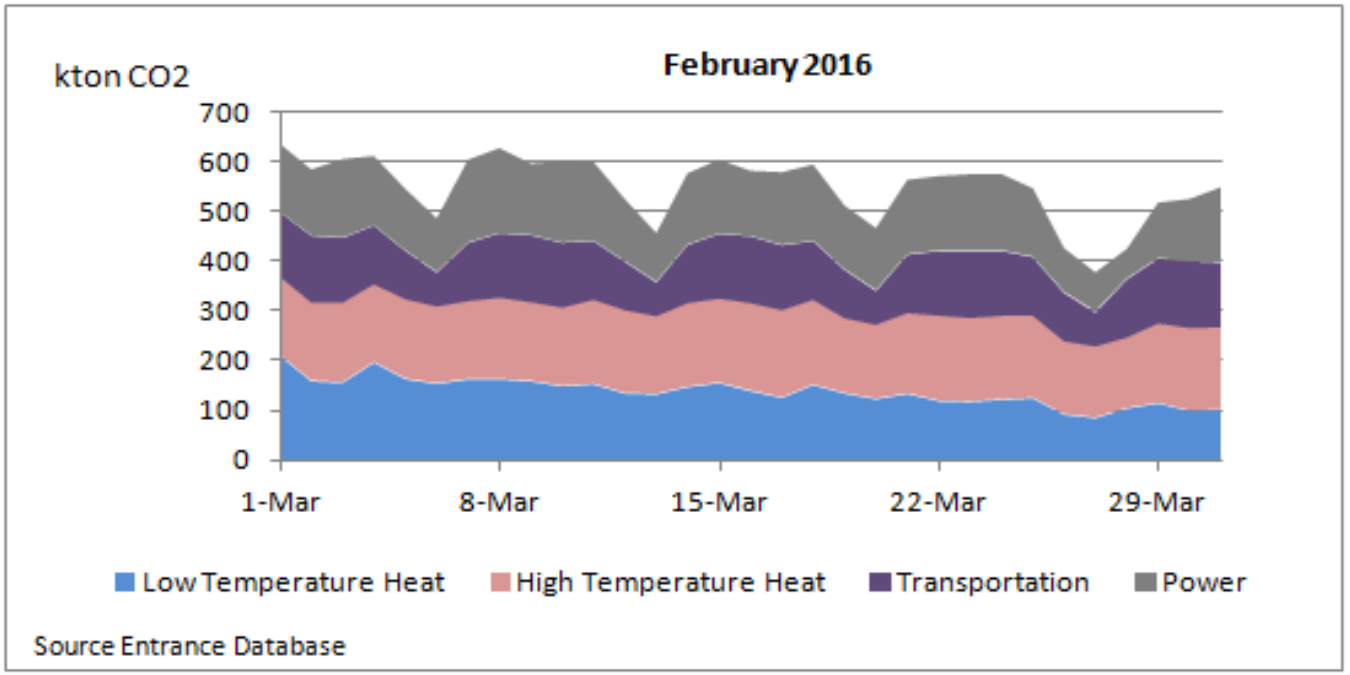

This figure shows the daily CO2 emission of each of the four demand sectors.

This figure does not take into account the energy demand for shipping, aviation and feedstock.

(1 kton CO2 is equal to the average daily CO2 emission of 90.000 households, each using 1500 m3 gas and 3500 kWh electricity .

CO2 emissions
Low Temperature Heat

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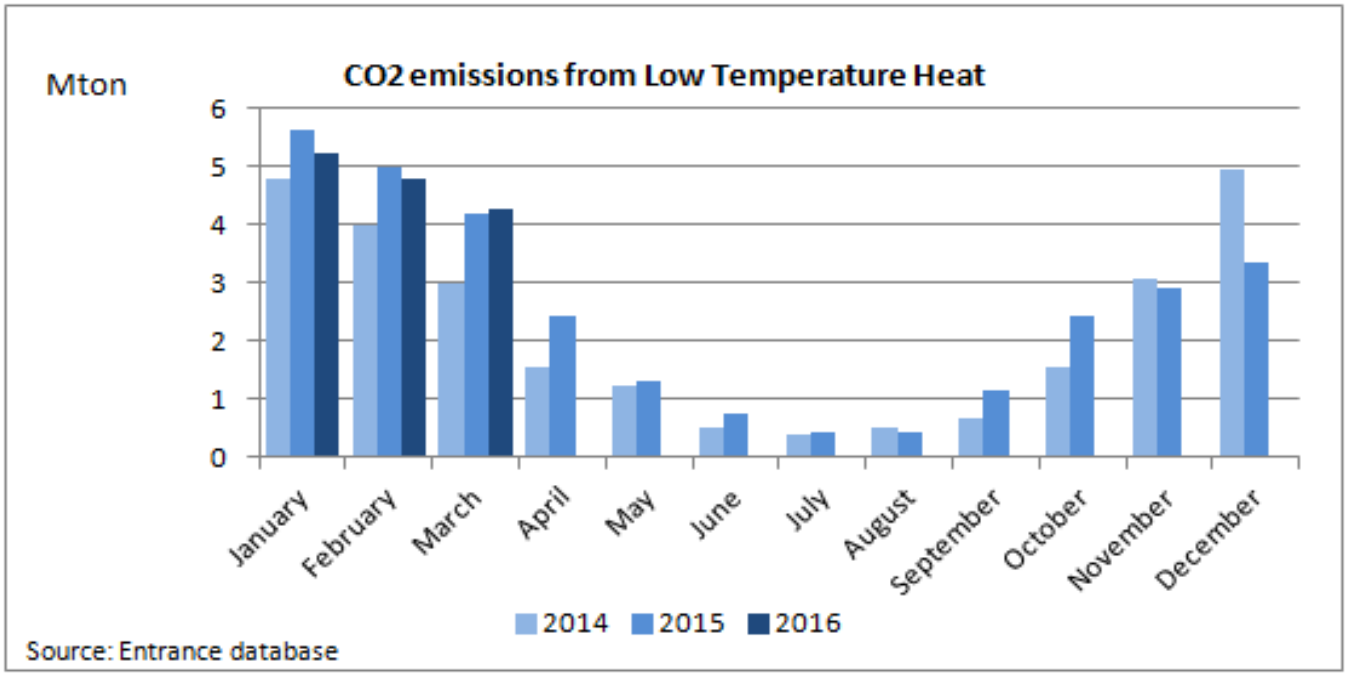
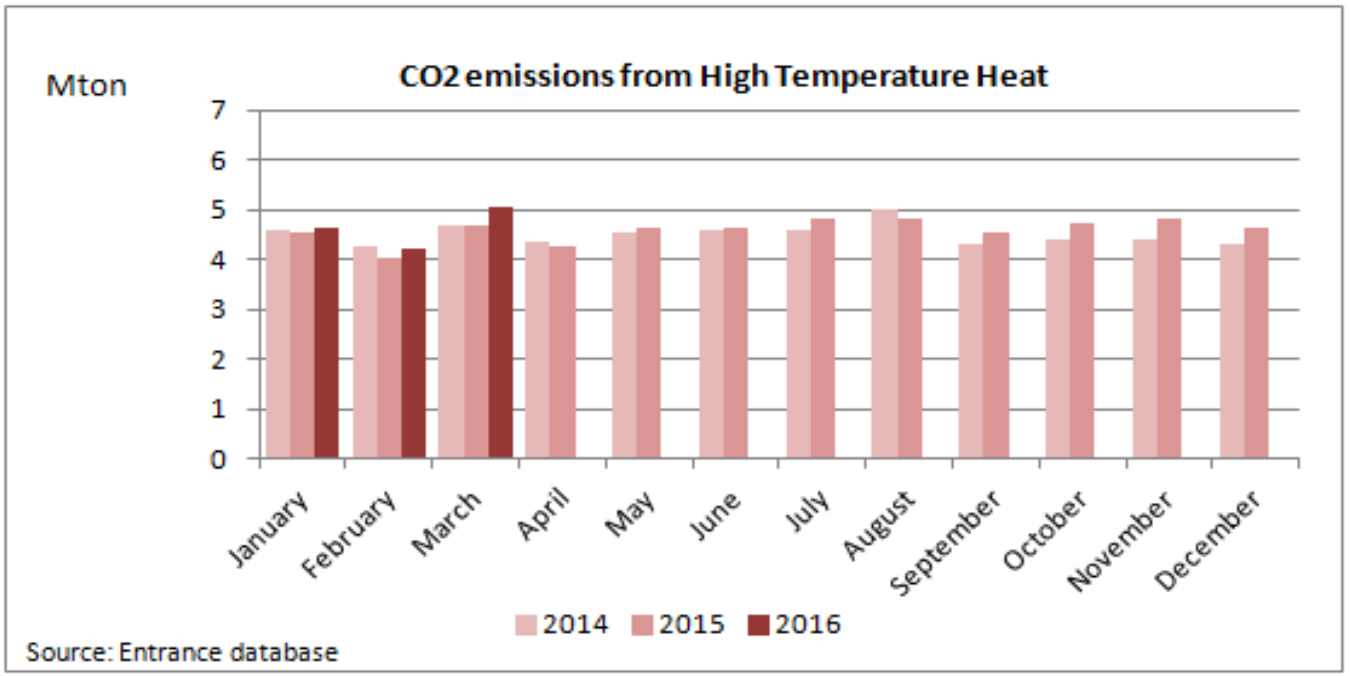


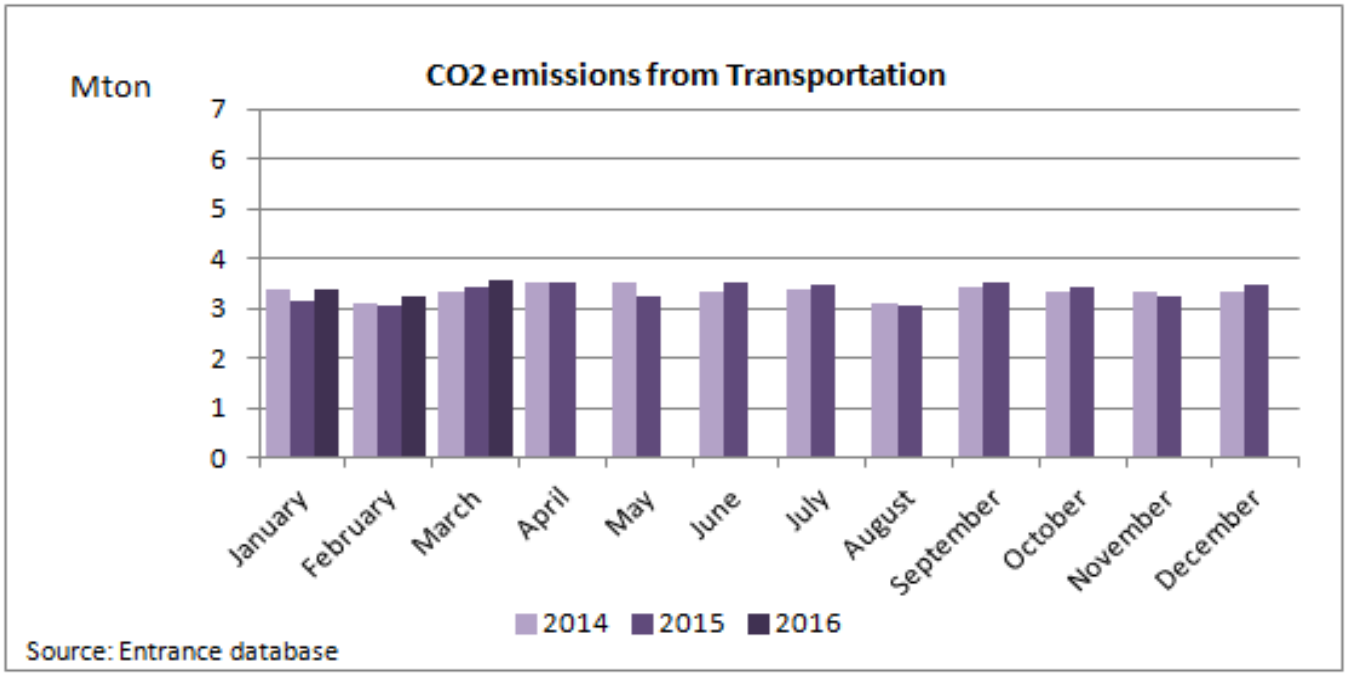
CO2 emissions from Low Temperature Heat , mainly buildings and green houses, vary with ambient air temperature and the fraction of renewable energy which is used, biomass and heat pumps.

CO2 emissions
High Temperature Heat



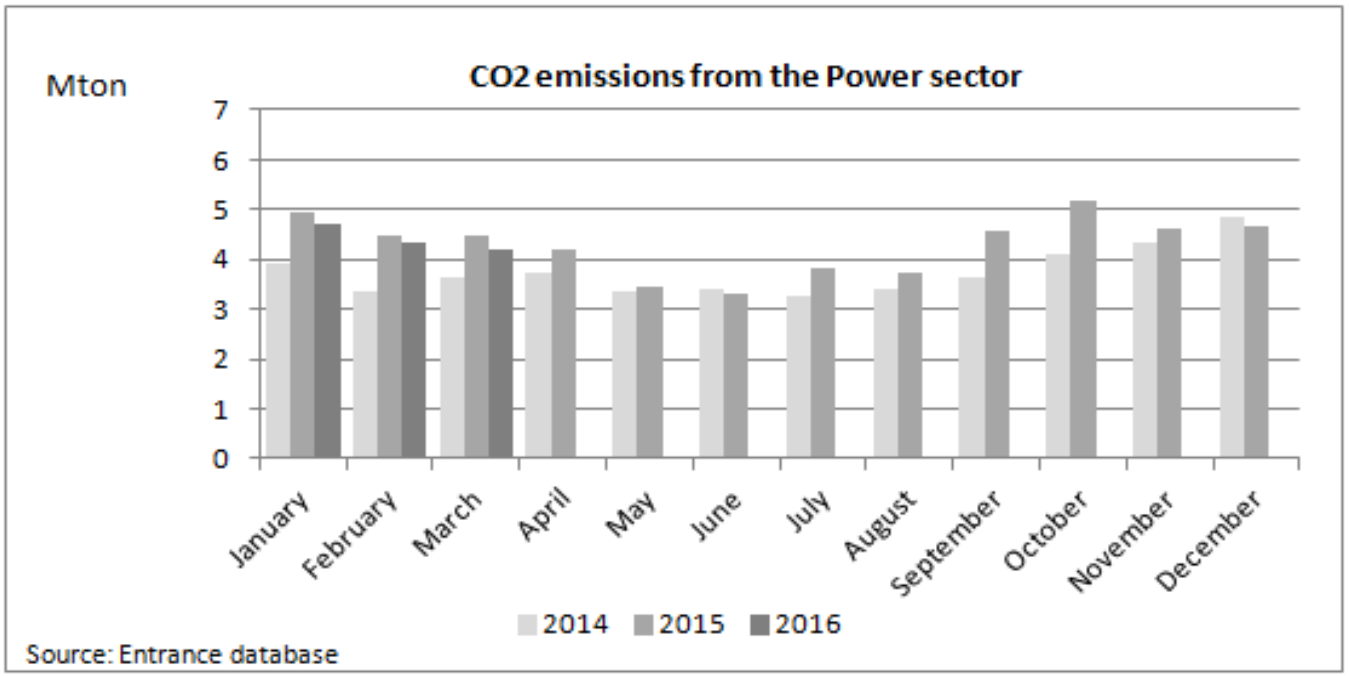
CO2 emissions from High Temperature Heat, mainly industry, vary mainly with the economic activity in the Netherlands.

CO2 emissions Transportation



CO2 emissions from Transportation (excluding international shipping and aviation, which are not accounted for in the national CO2 emissions) vary with the economic activity in the Netherlands. Fuel that is bought abroad, e.g. because of lower prices, is not included in this figure as well.

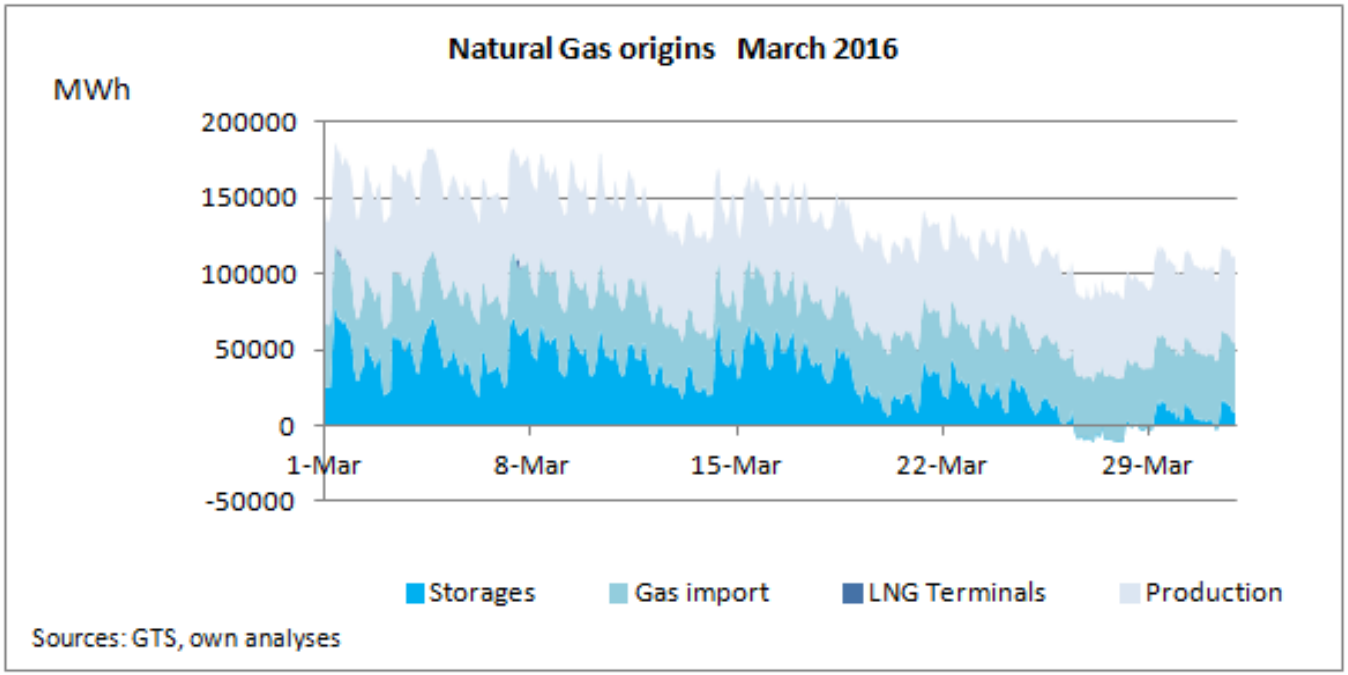
CO2 emissions Power Sector



CO2 emissions from the power sector vary with the amount of coal used for power generation, the amount of renewable power produced, and the level of power imports.

SELECTED HOURLY ENERGY DATA

Gas Supplies March 2016



The send-out of the gas storages is mainly related to ambient temperatures, but shows as well a week-weekend pattern. During Eastern, the storages were injecting some gas. Gas supplies include Dutch consumption and exports.

Gas Demand
Including Gas-to-Power
March 2016

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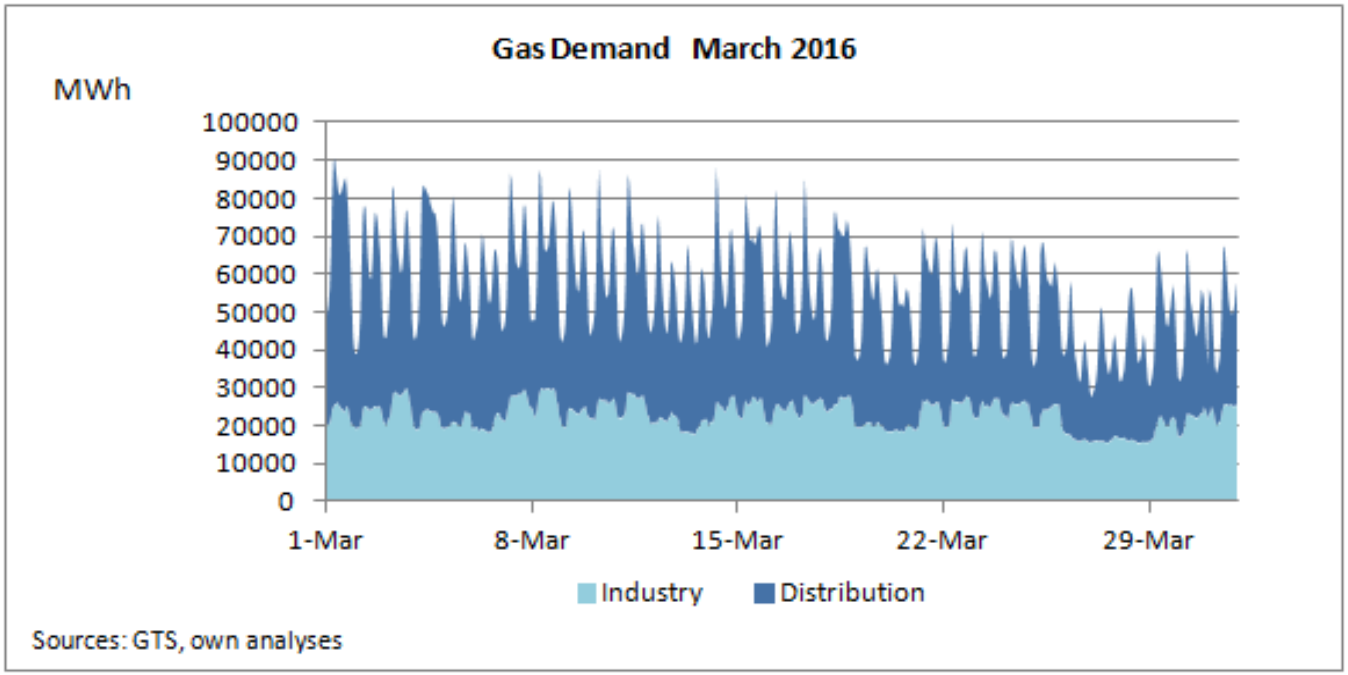
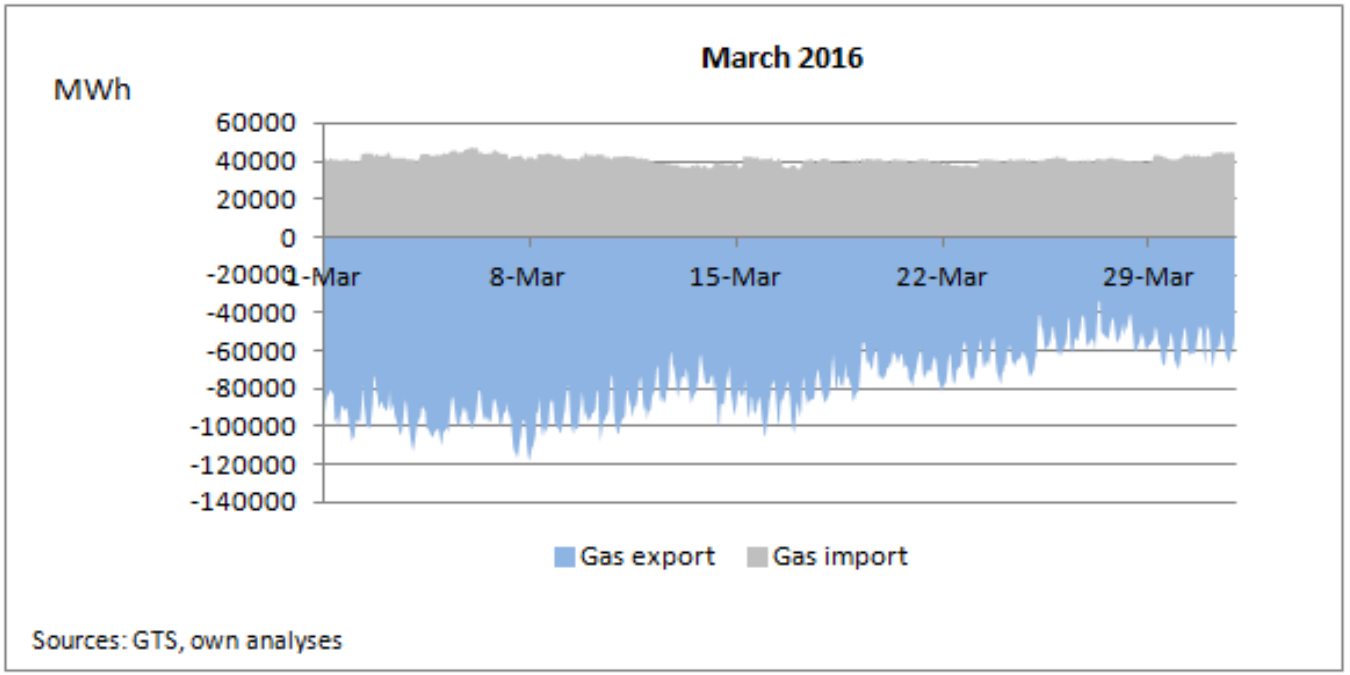


Domestic gas demand peaked at 90.000 MWh on March 1st. The term "Industry" is defined as direct connections to the Gasunie grid. 'Distribution' includes significant other industrial gas demand as well, estimated at 50 TWh annually, or 5700 MWh per hour. These other industries have a connection with the distribution network.

Gas Imports & Exports March 2016



In March, gas exports were 58 TWh (about ≈6 bcm), while gas imports were 31 TWh (≈ 3 bcm).

Power Imports & Exports March 2016

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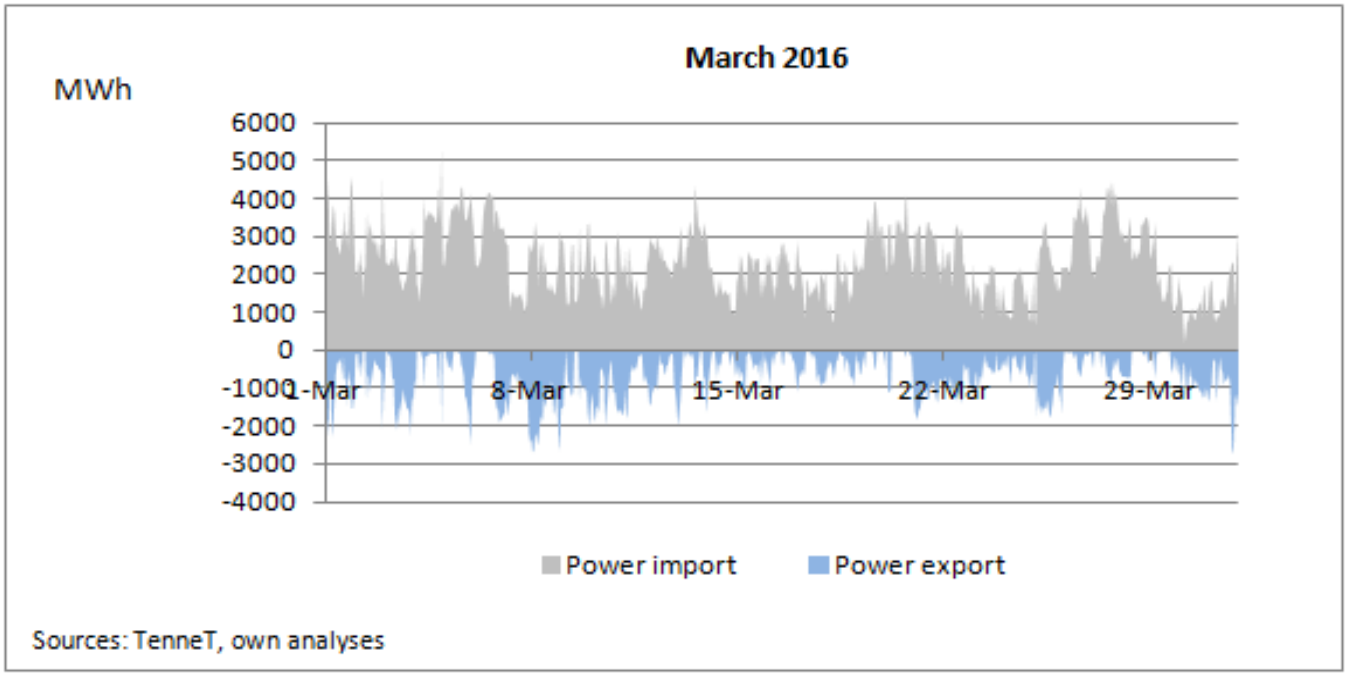
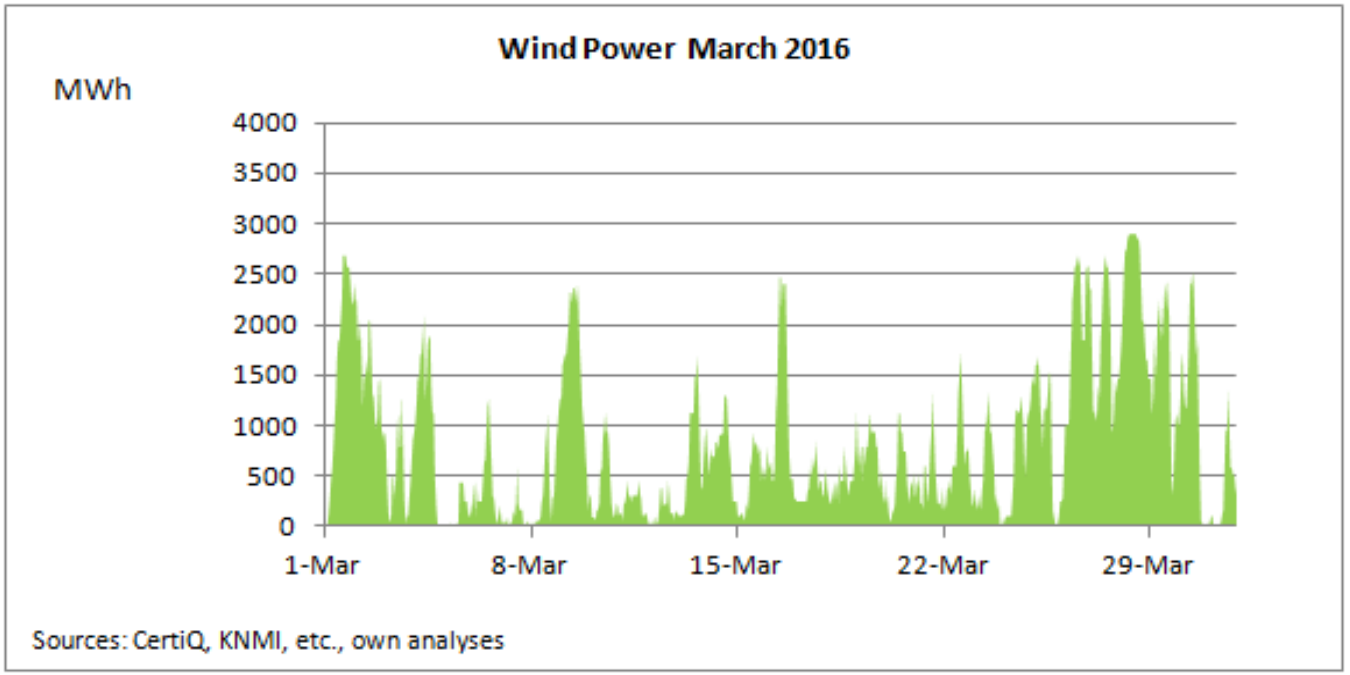


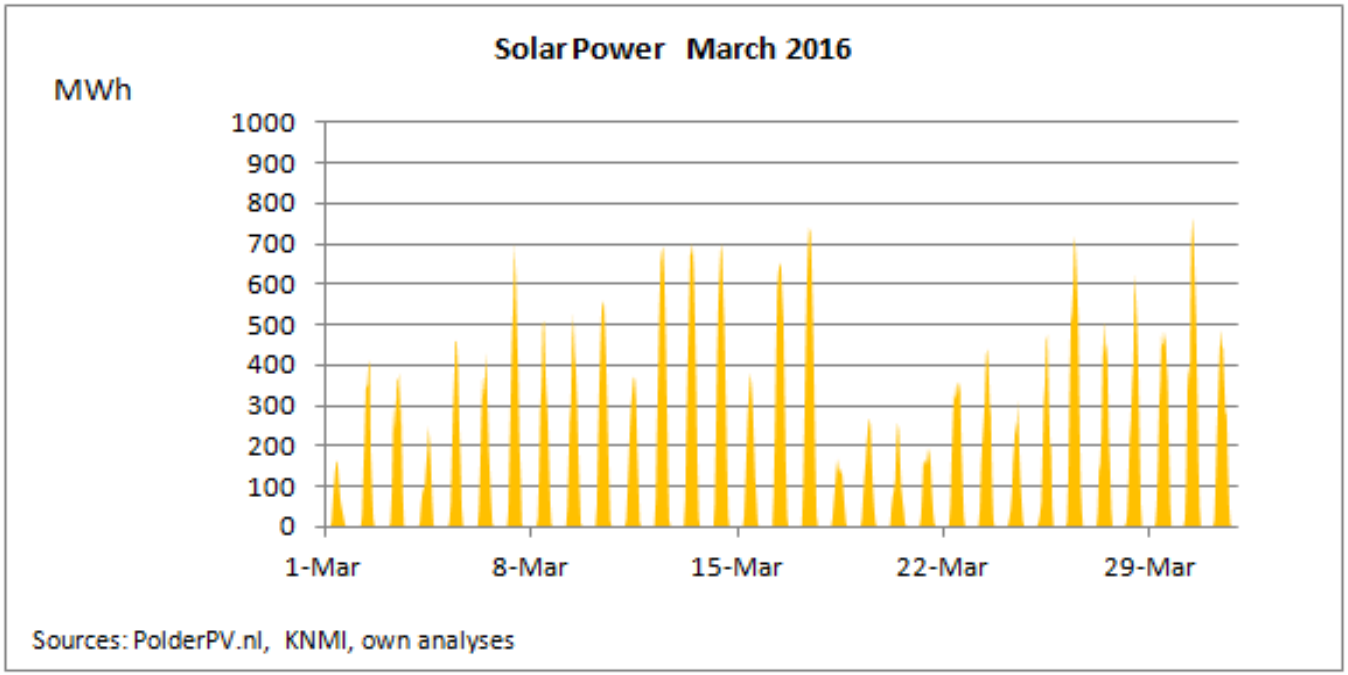
In March 2016, hardly any power exports occurred. The power imports totaled 1.7 TWh, while power exports were only 0.5 TWh.

Wind Power March 2016



March 2016 was characterized by low wind availability, with the exception in the period 26-30 March, which coincided with Eastern. The average utilization rate of the Dutch wind turbines was 24%.

Solar PV Power March 2016



March was rather sunny, but sun intensity in March is still limited. Hence, the utilization rate of more than 1500 MW of solar PV installed was not high. On average it was 8%.

The following set of slides presents for each month in 2016 the hourly contributions of various energy sources to total power consumption in The Netherlands.

Power Generation January 2016

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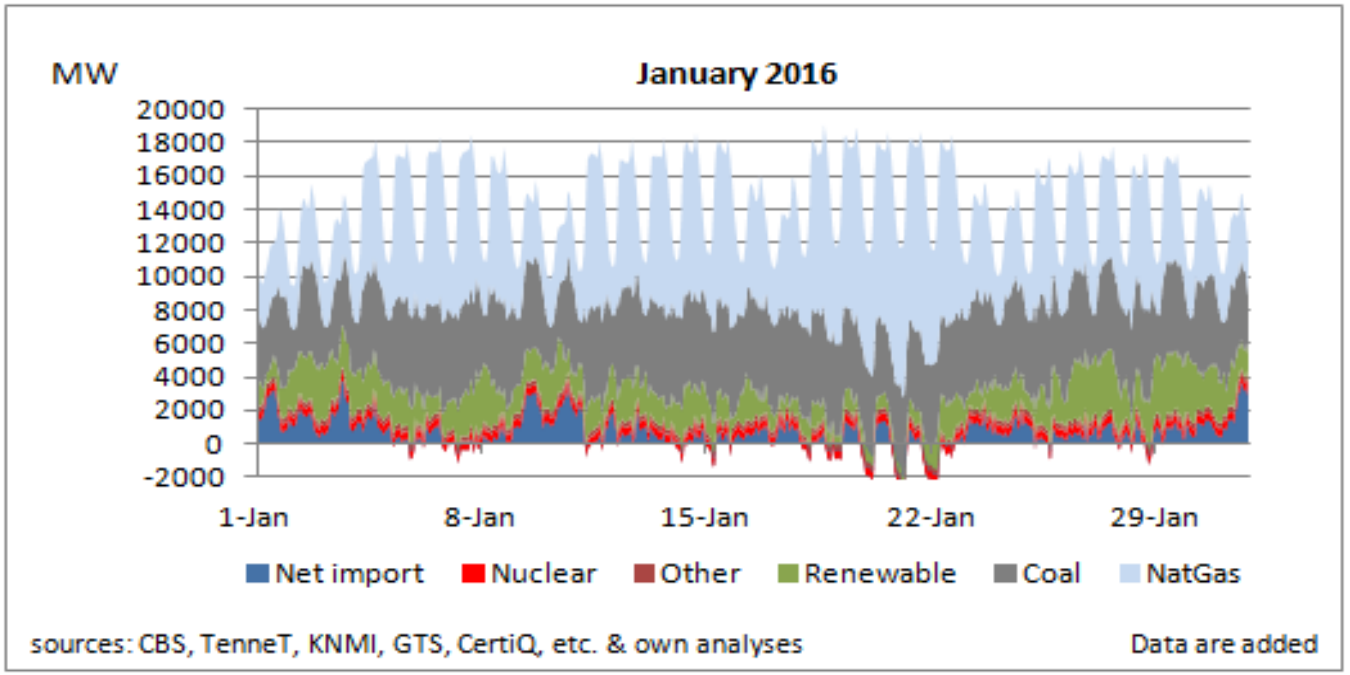
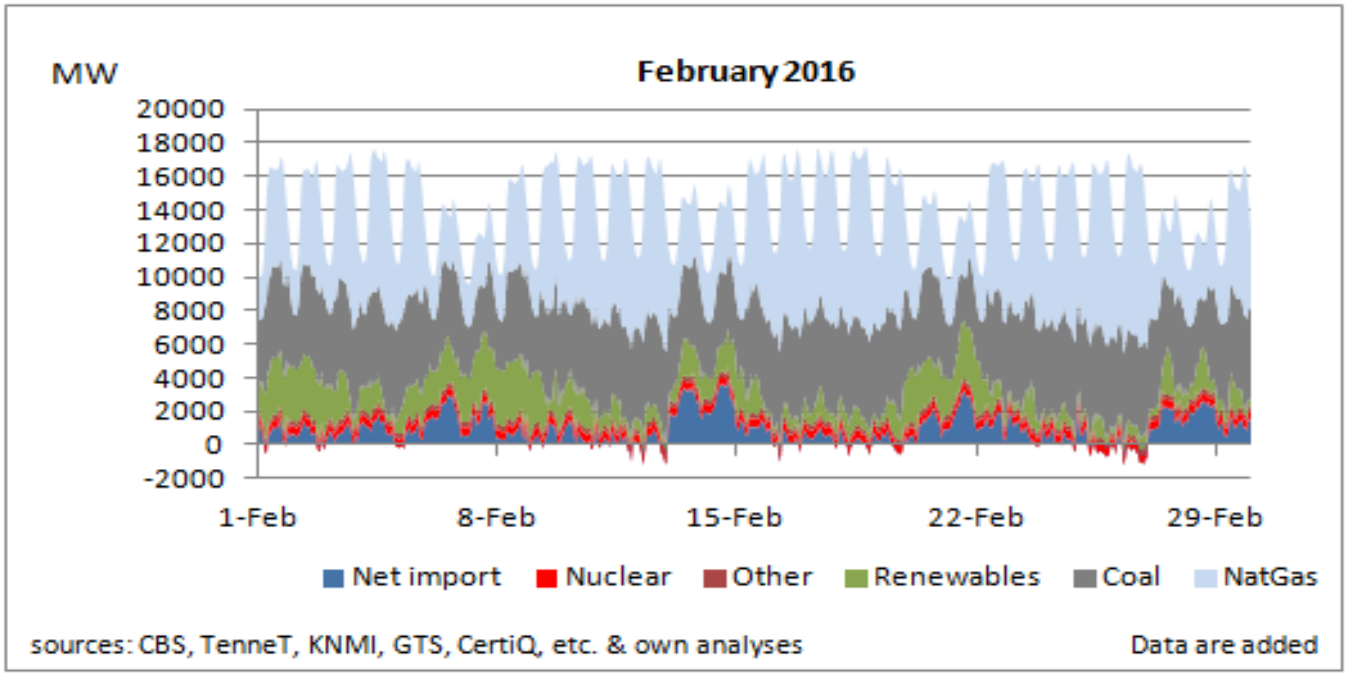


In the week of 19-23 March, gas-fired power generation peaked, due to low wind availability and net exports that occurred simultaneously.

Power Generation February 2016



In the second half of March, gas-fired power generation peaked, due to low wind availability and low imports.

Power Generation March 2016

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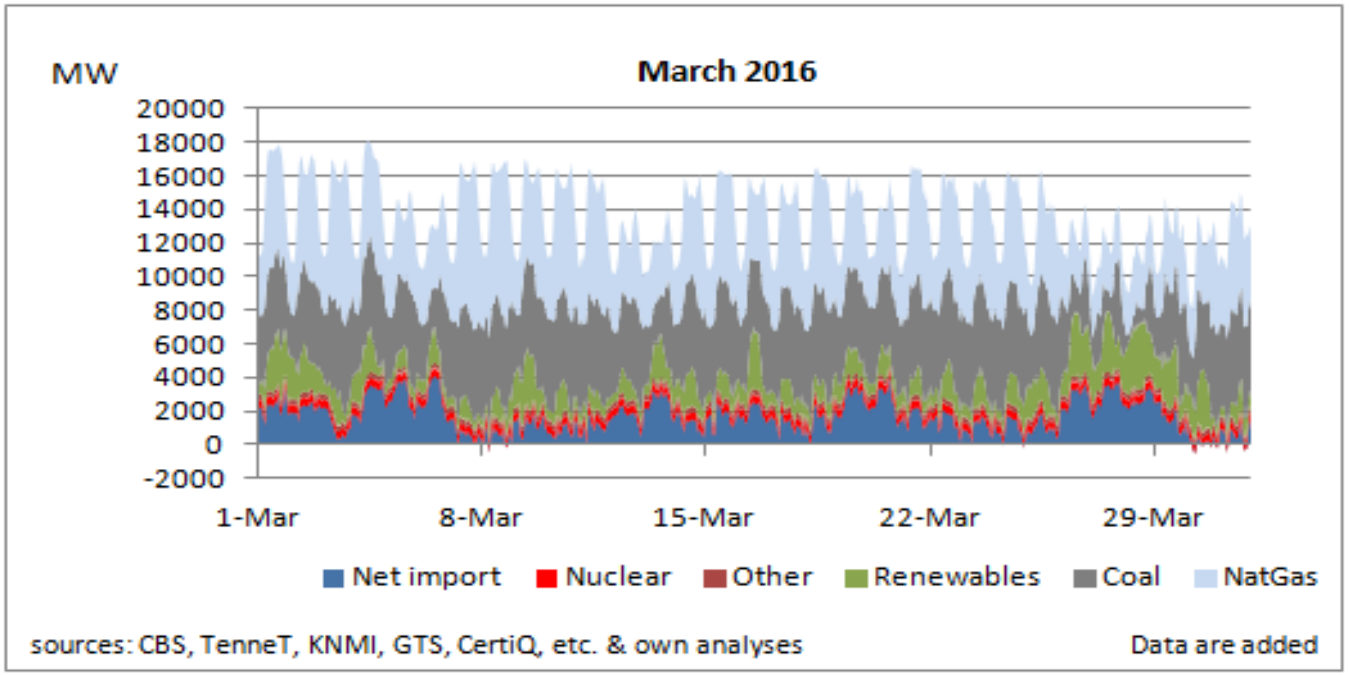

Around Eastern, the demand for power was relatively low and there was a high availability of wind, both domestic and imported. Hence, significant domestic gas and coal-fired power production had to be taken out.

The following set of slides presents for each week in 2016 the hourly contributions of wind and solar-PV to the total power consumption in The Netherlands.

Hourly Solar-PV and Wind Generation 2016

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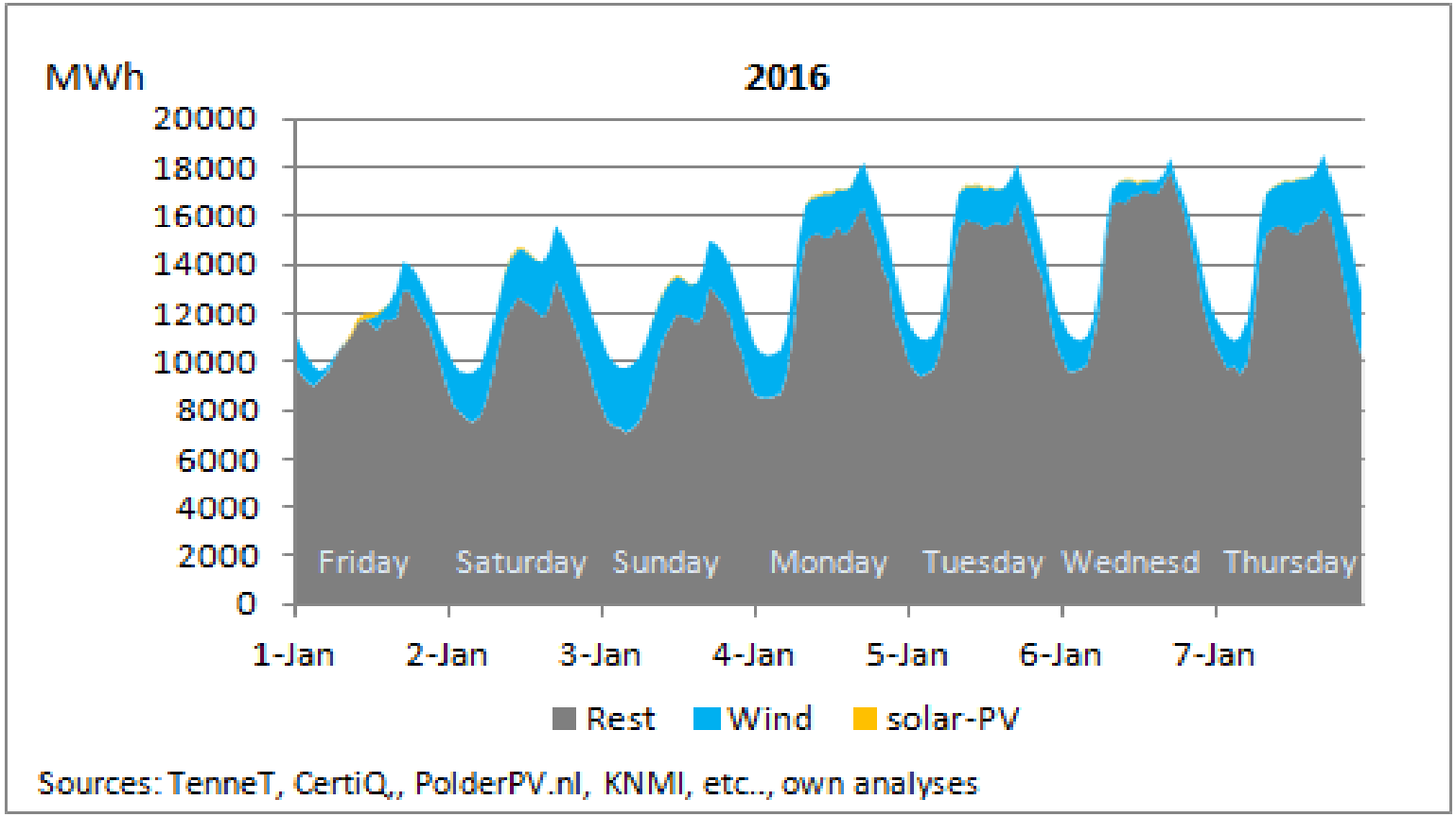

Hourly Solar-PV and Wind Generation 2016

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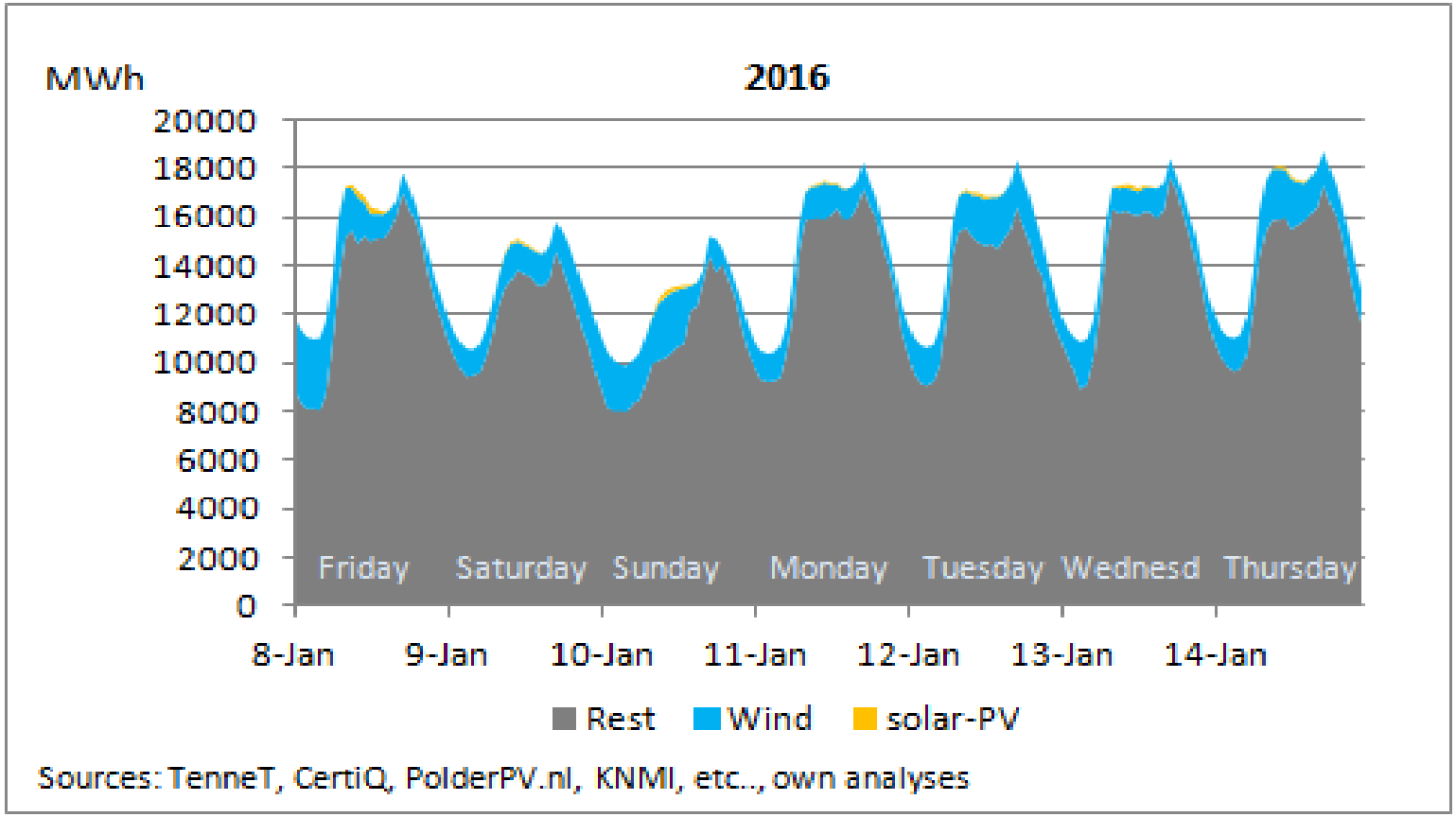
ENERGY TRANSITION CENTRE



Hourly Solar-PV and Wind Generation 2016

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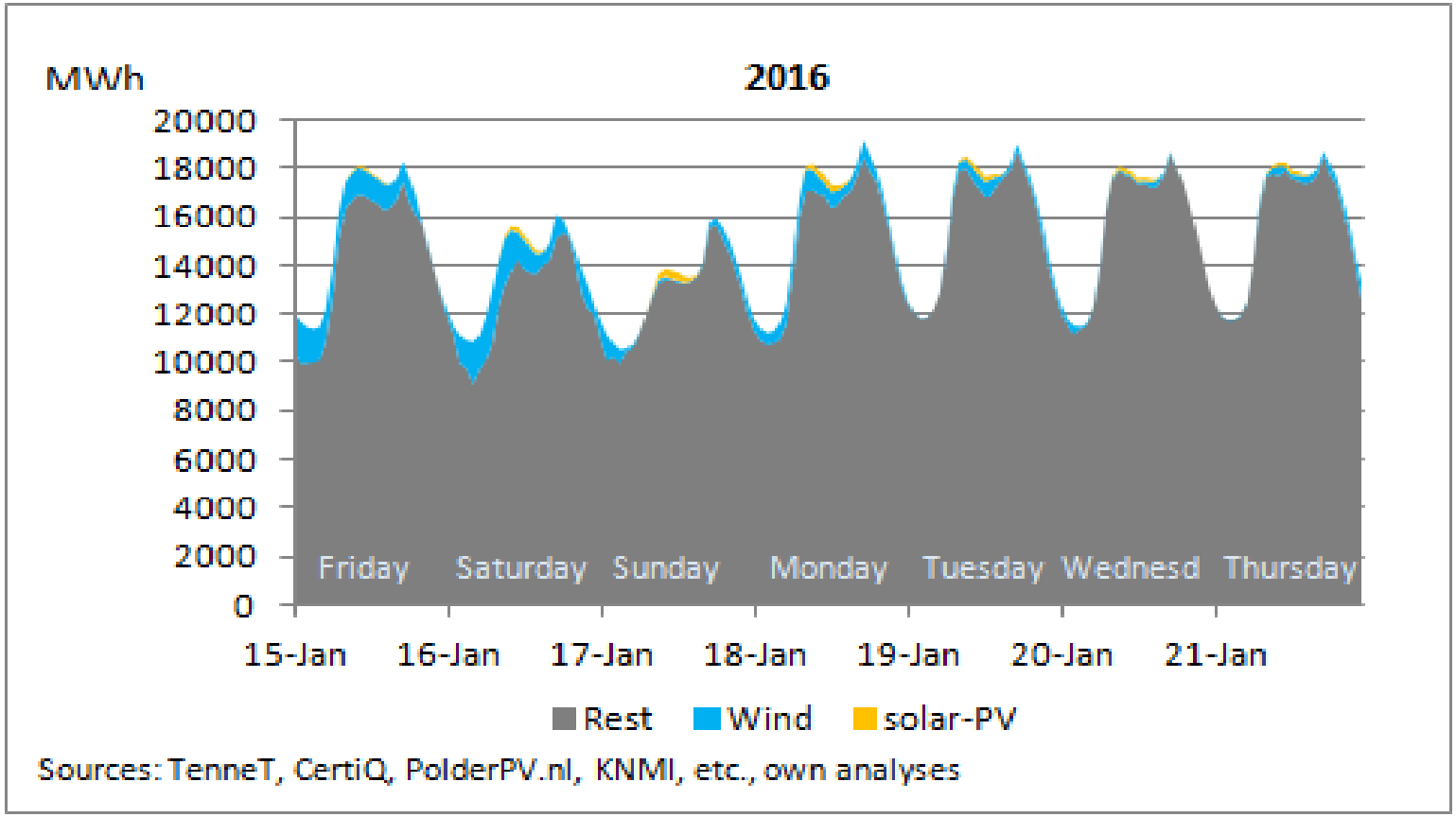
ENERGY TRANSITION CENTRE



Hourly Solar-PV and Wind Generation 2016

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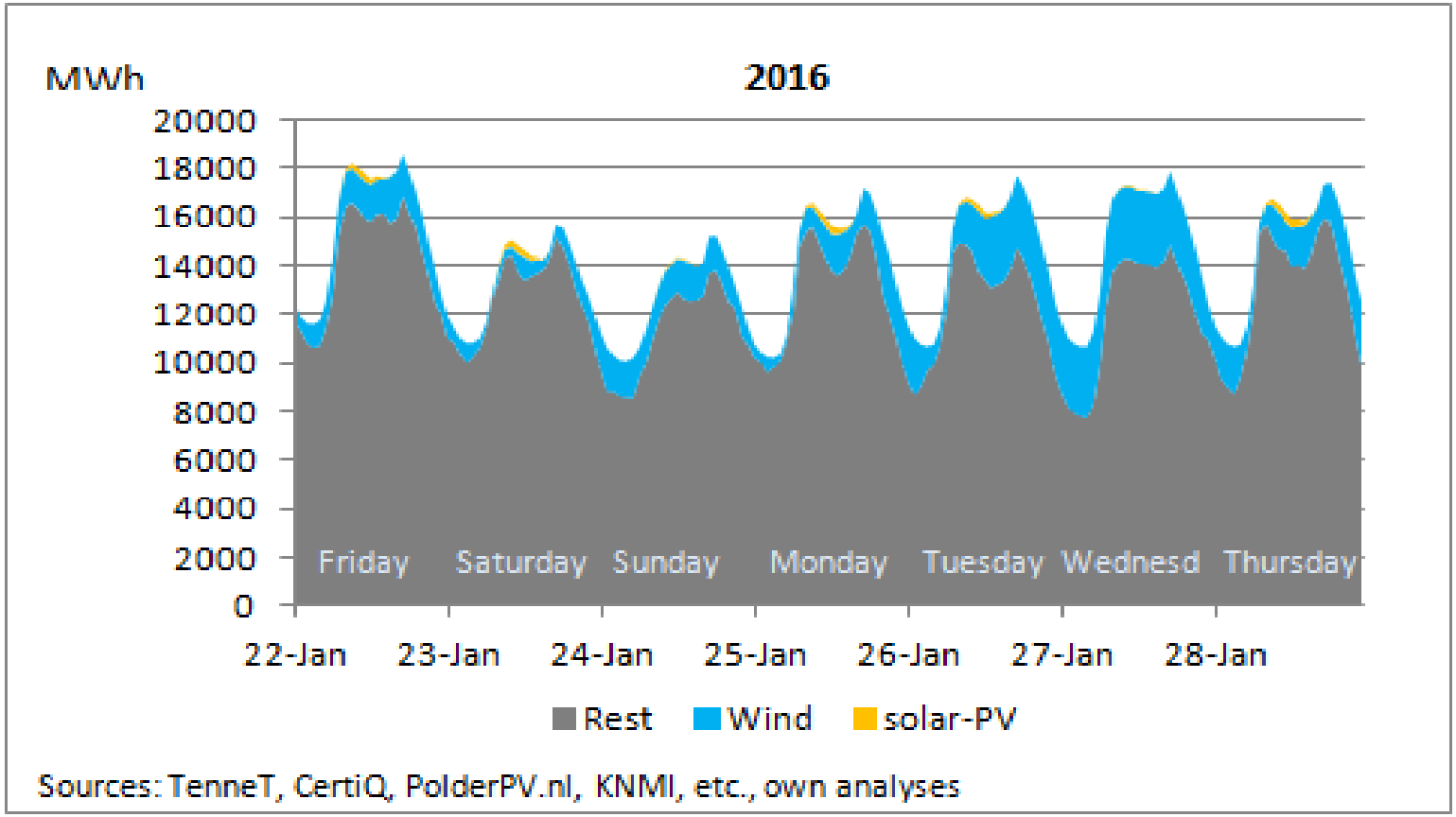
ENERGY TRANSITION CENTRE



Hourly Solar-PV and Wind Generation 2016

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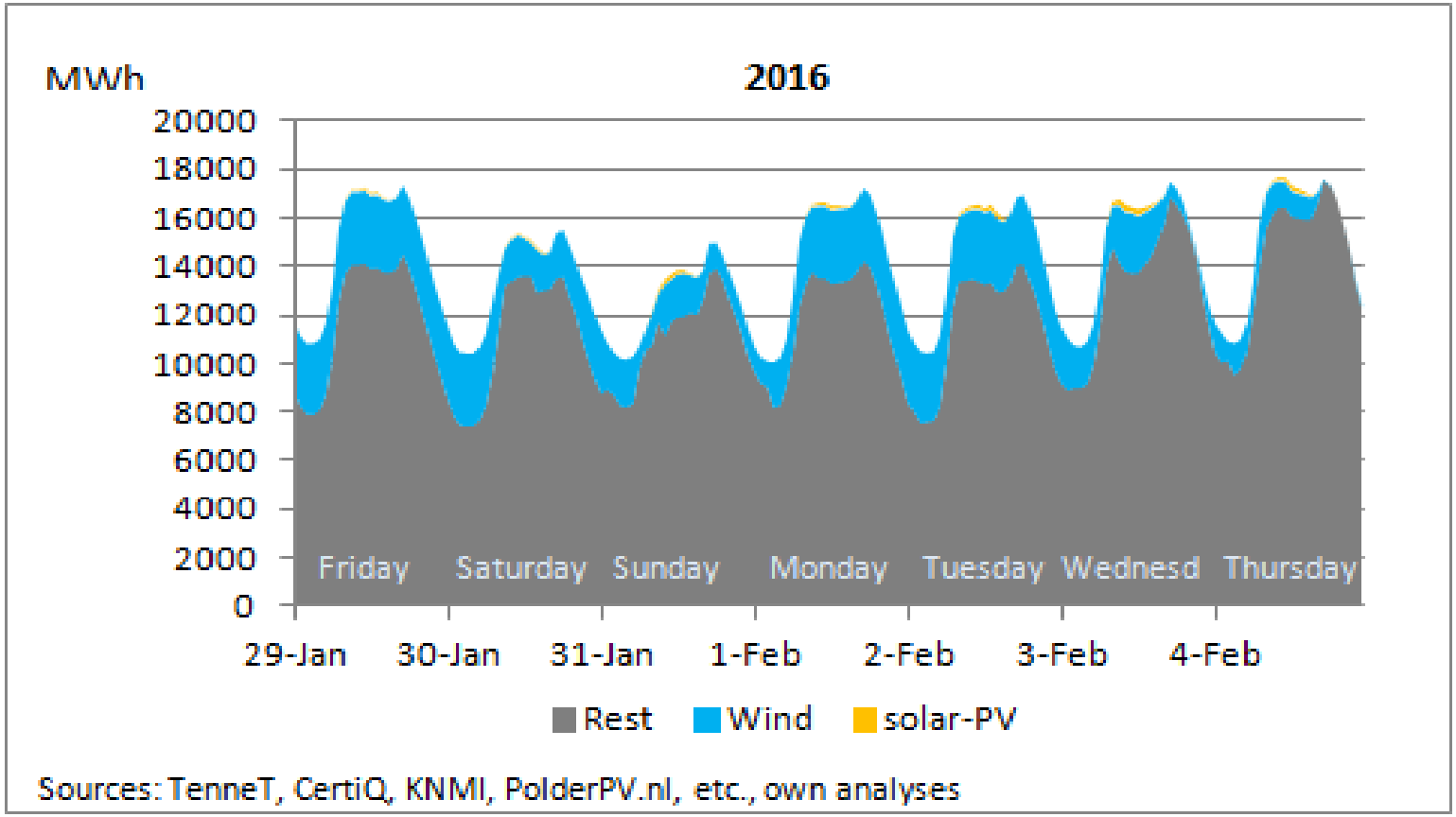
ENERGY TRANSITION CENTRE



Hourly Solar-PV and Wind Generation 2016

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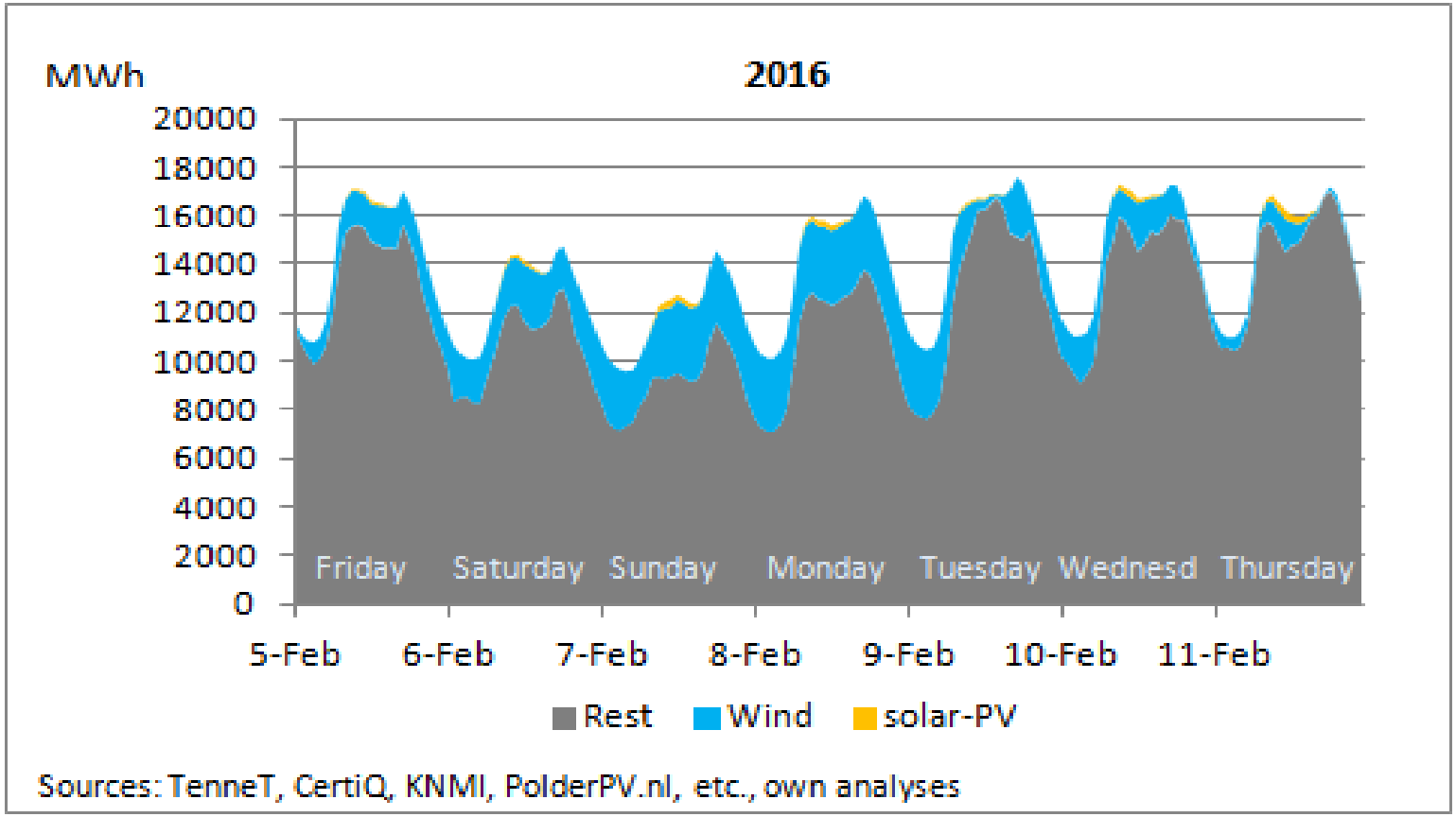
ENERGY TRANSITION CENTRE



Hourly Solar-PV and Wind Generation 2016

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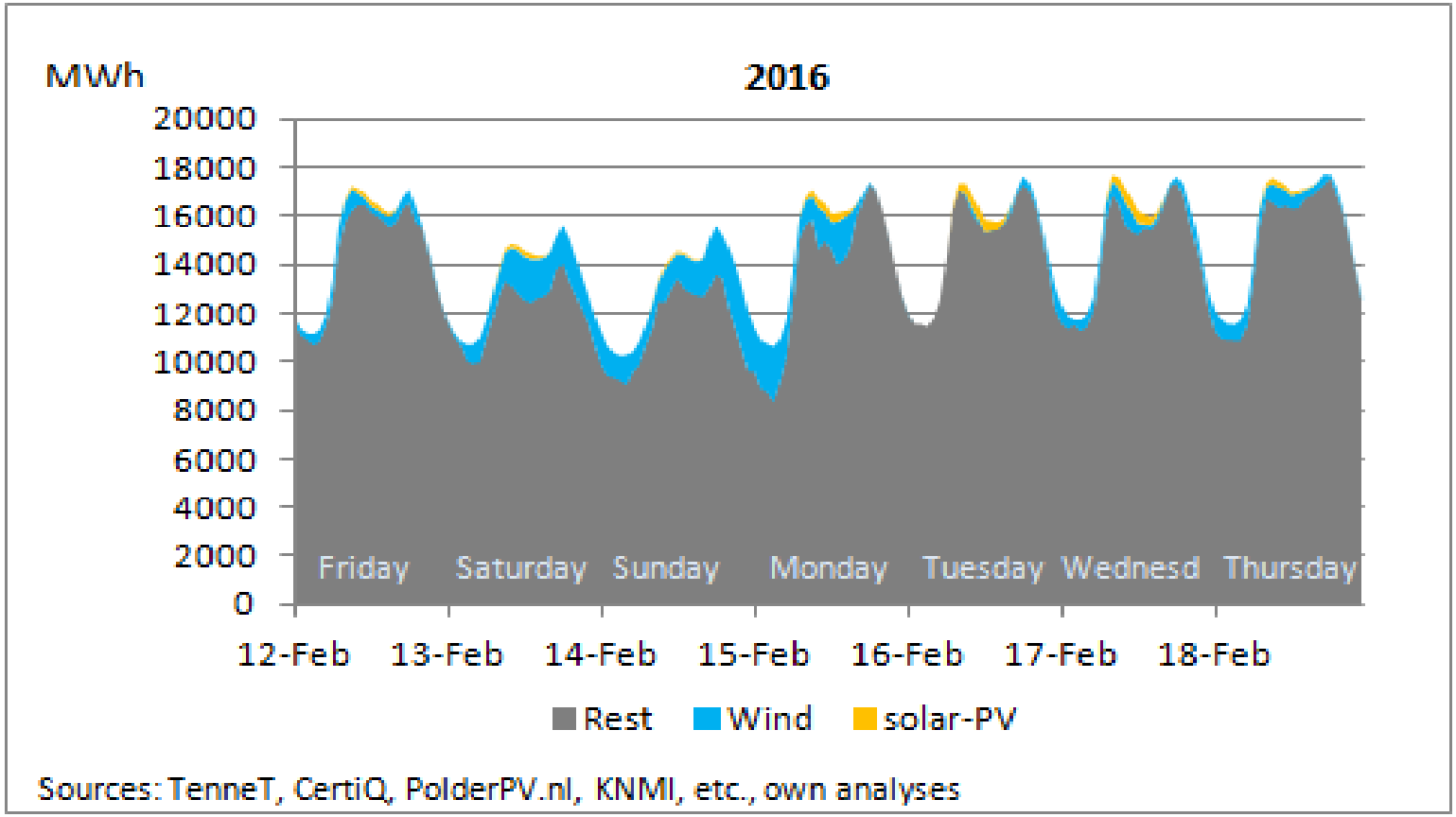
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, PolderPV.nl, KNMI, etc., own analyses

Hourly Solar-PV and Wind Generation 2016

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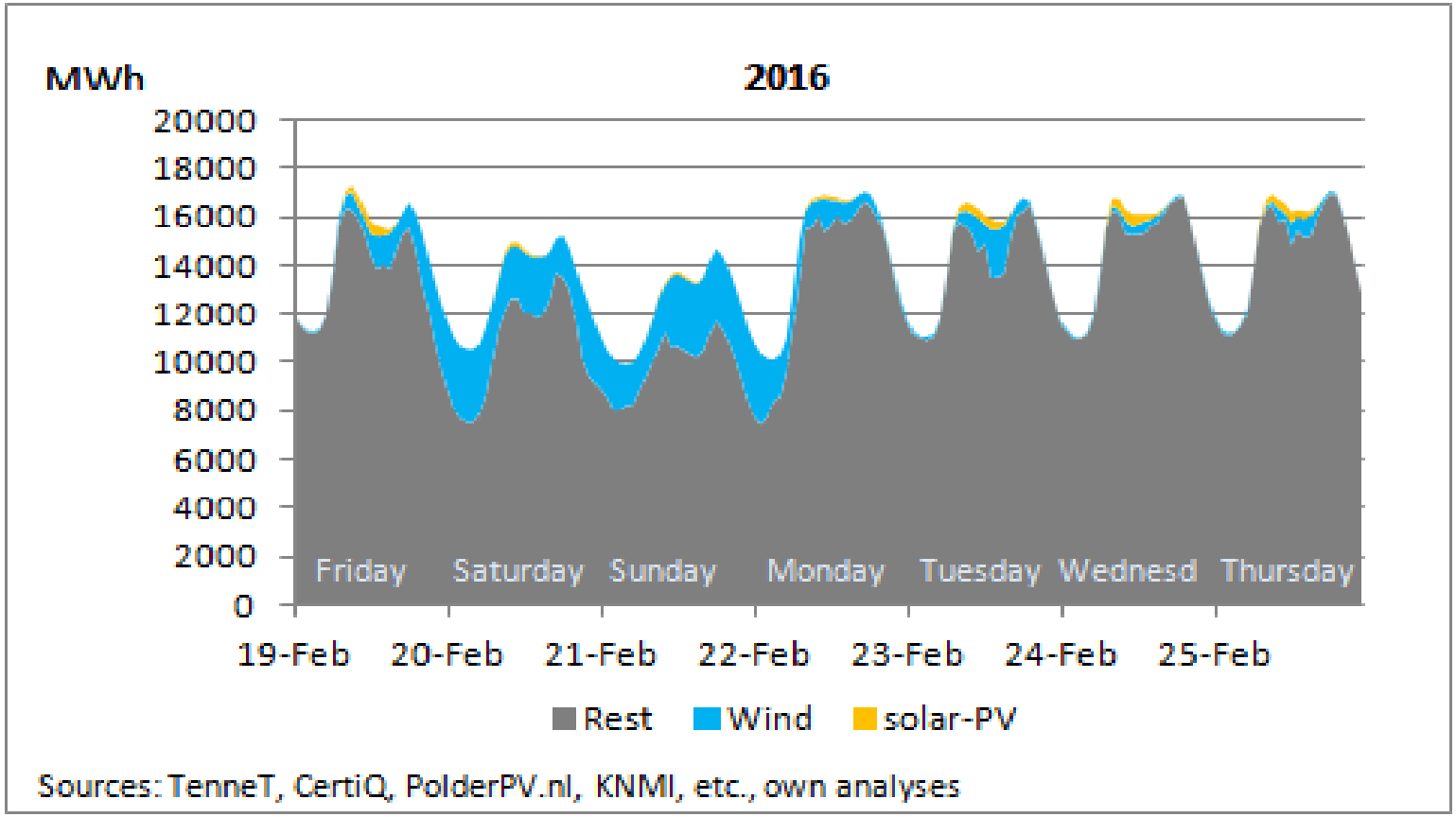
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, PolderPV.nl, KNMI, etc., own analyses

Hourly Solar-PV and Wind Generation 2016

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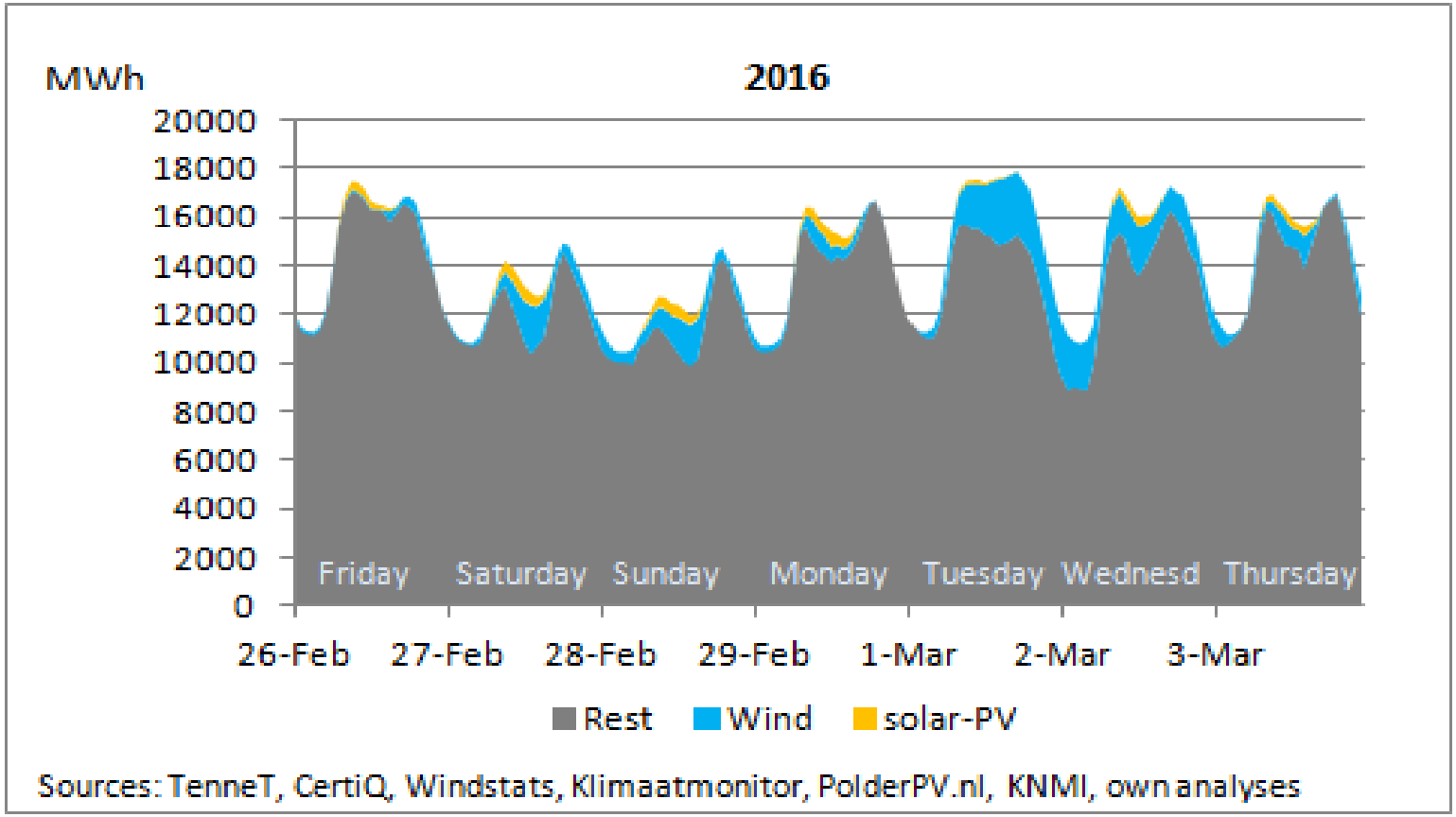
ENERGY TRANSITION CENTRE



Hourly Solar-PV and Wind Generation 2016

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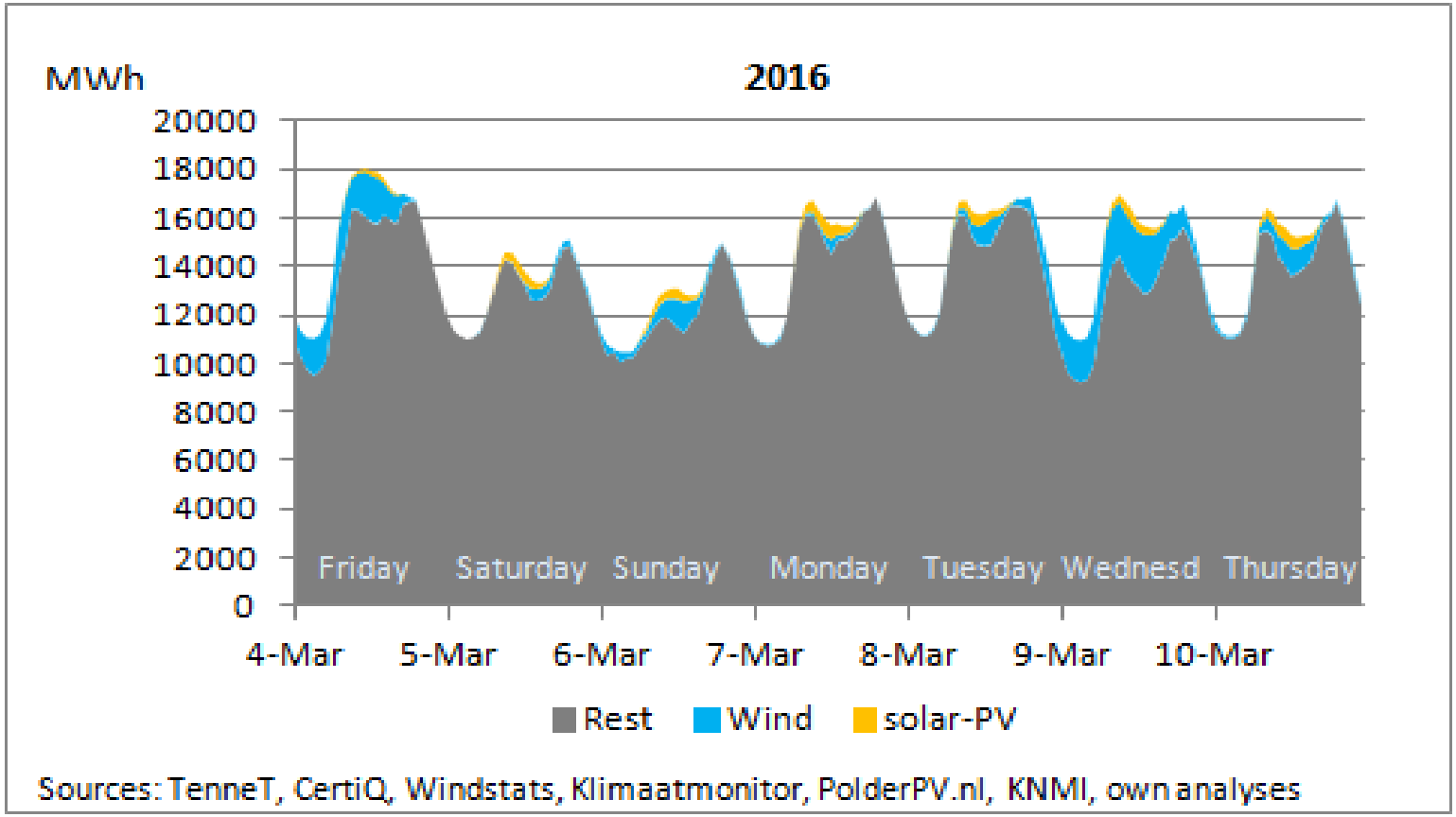
ENERGY TRANSITION CENTRE



Hourly Solar-PV and Wind Generation 2016

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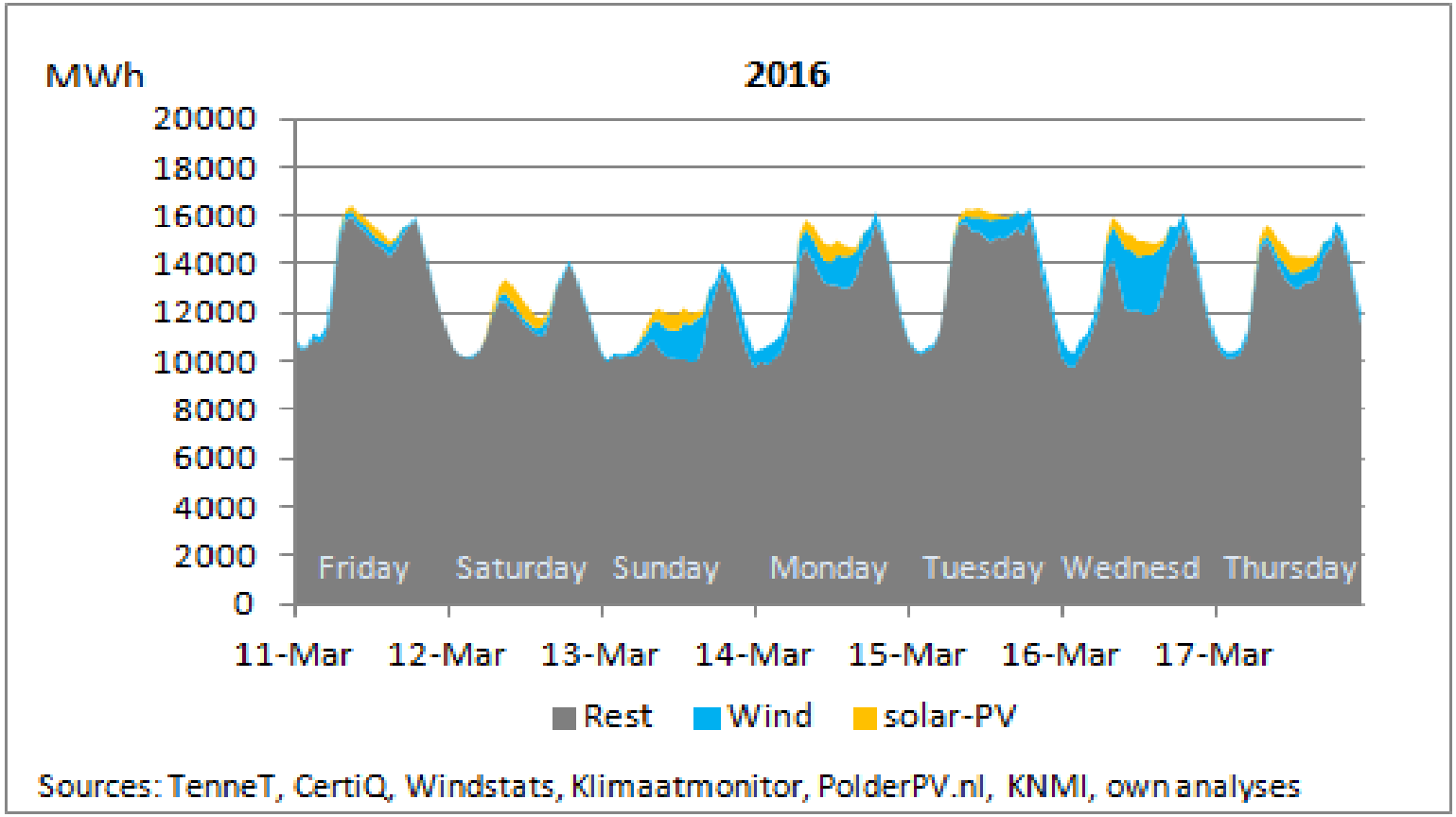
ENERGY TRANSITION CENTRE



Hourly Solar-PV and Wind Generation 2016

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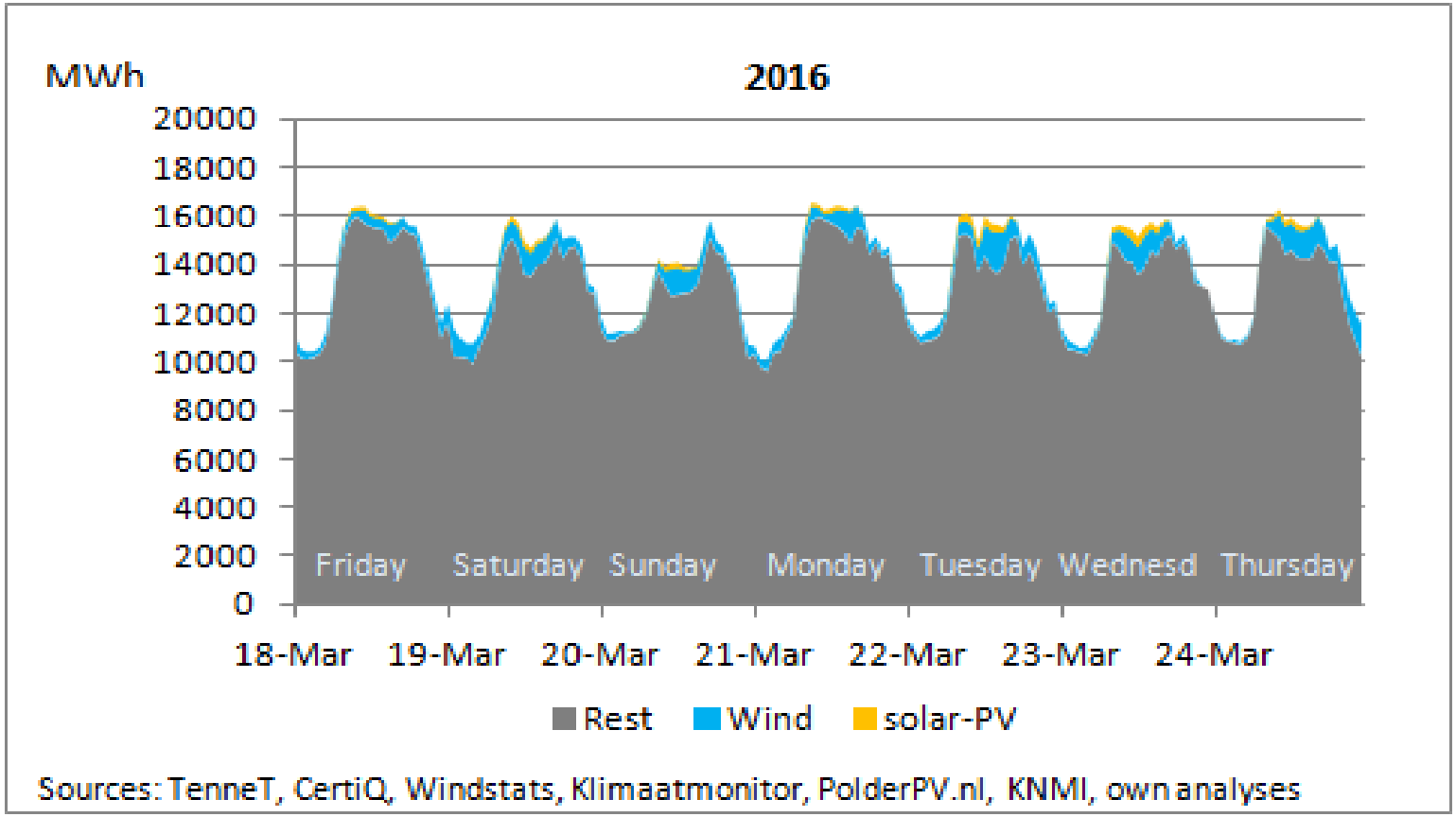
ENERGY TRANSITION CENTRE



Hourly Solar-PV and Wind Generation 2016

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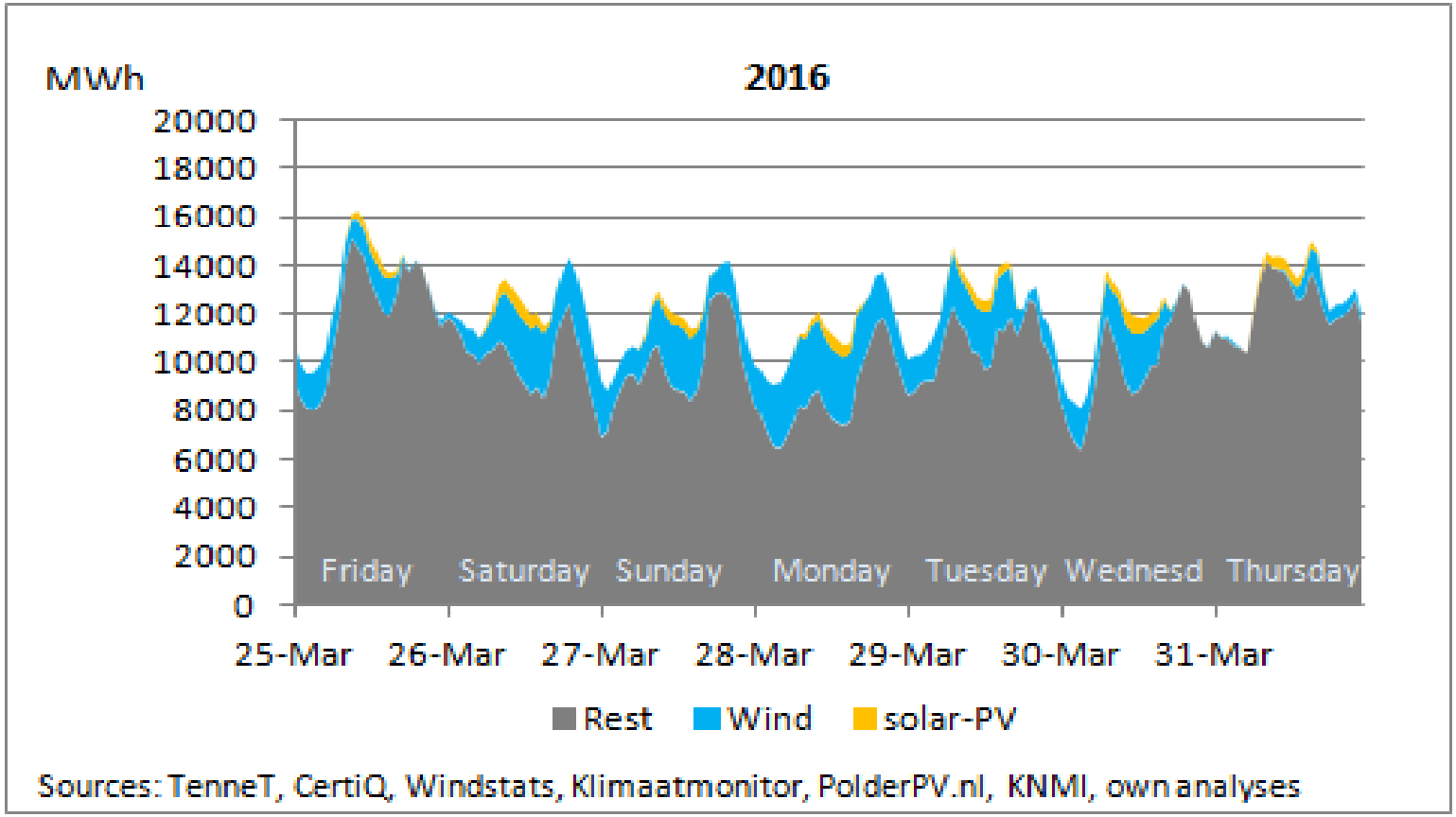
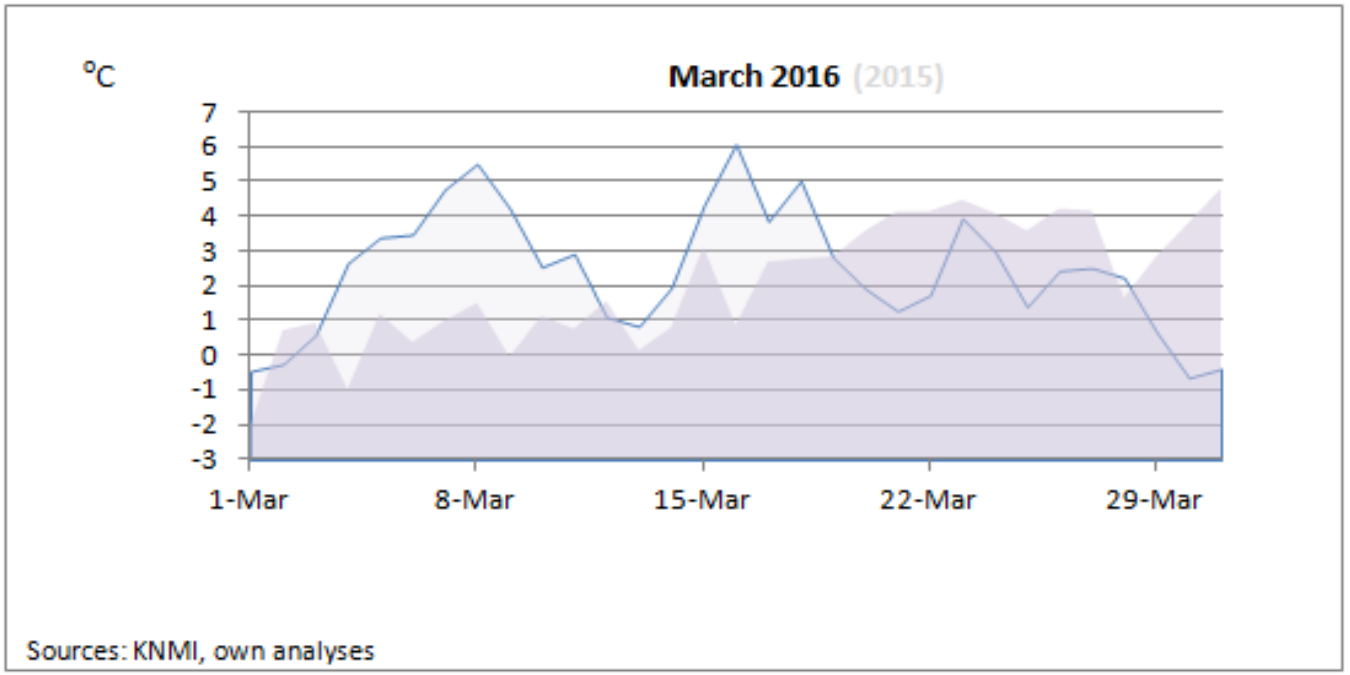
ENERGY TRANSITION CENTRE



MISCELLANEOUS

Effective Temperature March 2016



In March 2016, the average daily effective temperature (temperature including wind shield factor) was 0.6 °C, a bit higher than the same temperature of March 2015 (average 0.3°C).

Effective Temperature March 2016

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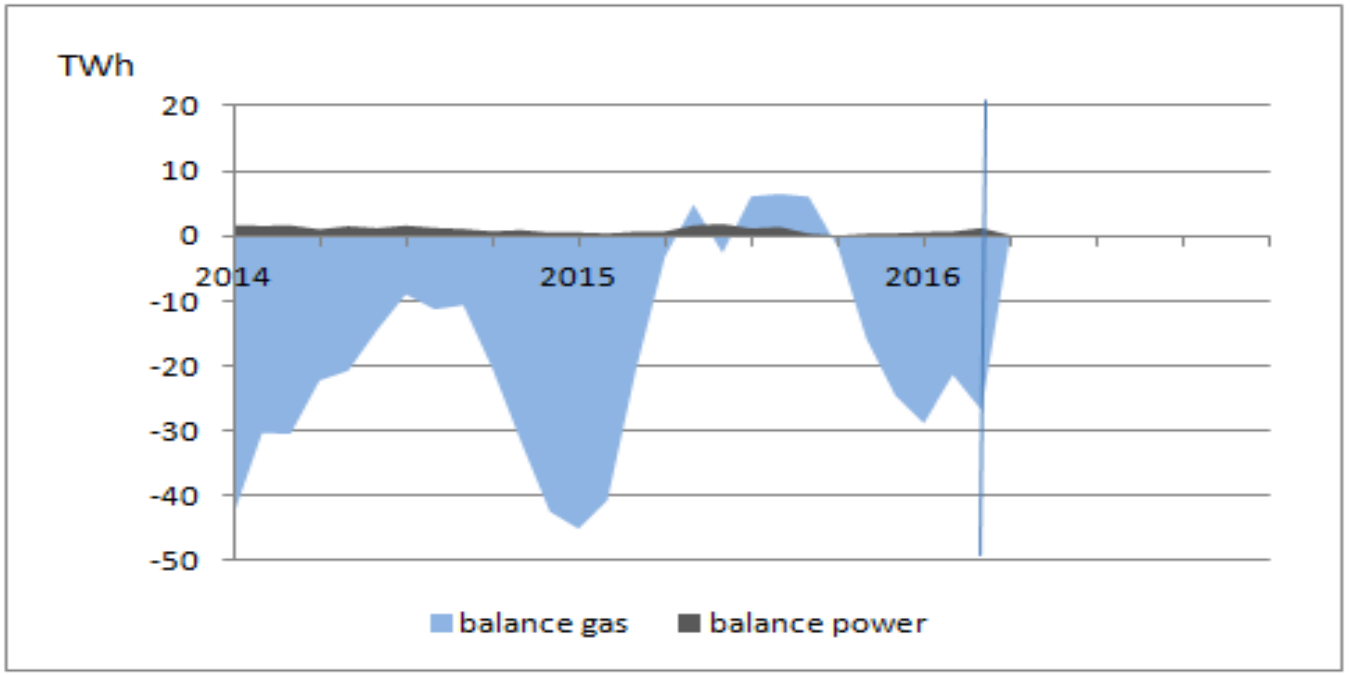
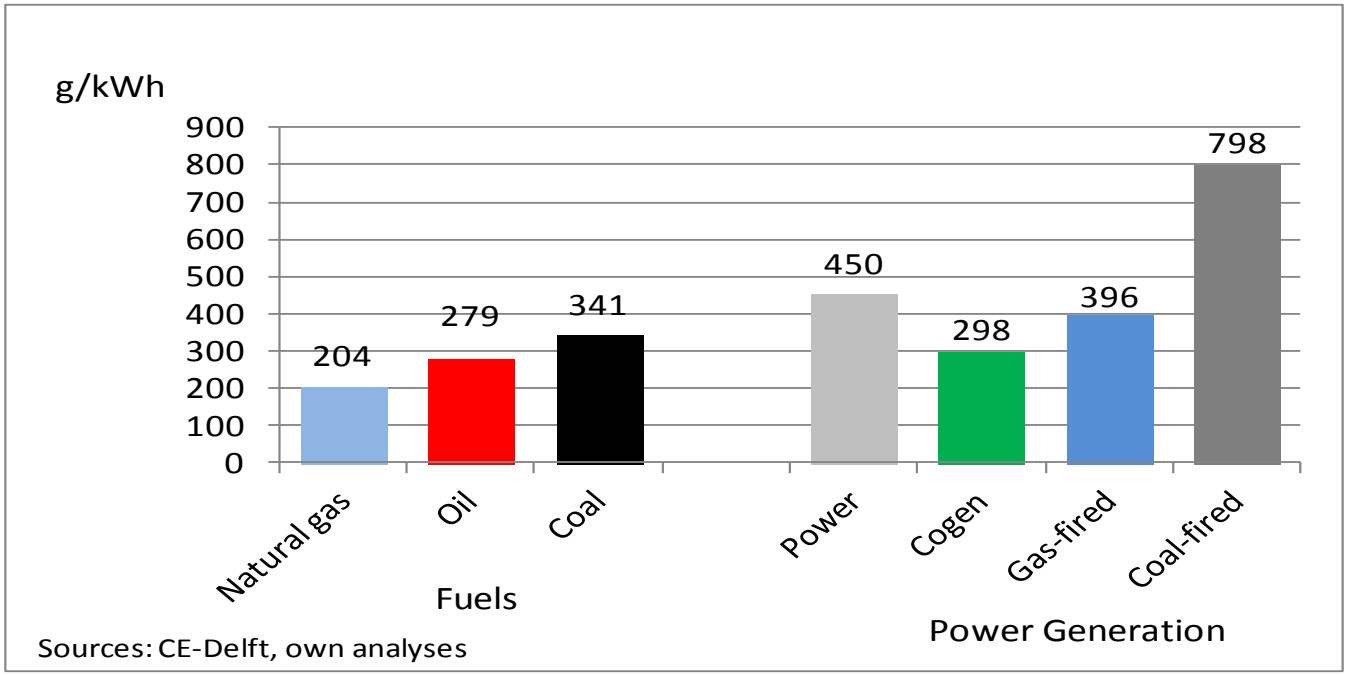


This curve represents the long term monthly net import/export balances of natural gas and power since January 2014. Negative numbers express net exports. Positive number net imports. Since 2015, the Groningen gas production has decreased significantly.

Fuel Specific CO2 Emissions



Characteristic CO2 emissions used in this presentation.

Epilogue

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This presentation is based on numerous sources which present data on energy demand and supply in The Netherlands. These data, however, do not cover the entire energy system. Some approximations and scaling factors were thus needed. The author would like to thank students from Hanze University of Applied Science in Groningen and various energy experts in The Netherlands which gave suggestions for improvements of the methods used. Currently, the aggregated results of this work are in good agreement with data supplied by the Dutch National Office of Statistics (CBS). It is believed by the author that the detailed results in this presentation give a fair presentation of the complex reality of the Dutch energy system.

Nevertheless, the author invites readers to comment on the data provided with the objective to further improve this work. After all, good and reliable data are at the heart of any successful policy to make our world more sustainable.